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Editorial Notes

The Provision of Comfort

IT can now be revealed that at any rate a certain part of this winter has not been unduly mild. In fact, we have it on good authority that in more than one district of this country plumbers have been busy. Now it does not in the least follow that the next winter will be a mild one; if one can judge from statistics compiled over very many years it is not likely to be mild. In any case this winter has brought into great prominence the importance of comfort heating by gas in the home, and it has also impressed us with how much greater comfort gas could provide the householder at very little added cost—or, maybe, at less cost than that entailed by frozen pipes and the like.

It will be admitted, we think, that the bathroom is a very important room in a house. It must be admitted, too, that surprisingly little attention is ever paid to the warming of the bathroom. The vast majority of houses in this country have no provision whatever for warming the bathroom. Yet the comfort of a warm bathroom in any winter has only to be experienced to be considered no longer in the light of a luxury but rather as a necessity. In a cold winter the additional warmth—and the bathroom often has two outside walls—makes a vast difference to the comfort conditions of the entire house and it spells freedom from anxiety and inconvenience due to the freezing-up of pipes. When, as we have said, this comfort and convenience can be afforded by gas at little cost, both in capital outlay and in running charges, it is equally surprising that the Gas Industry has made so little attempt to gain a useful load and at the same time greatly add to the goodwill of the consumer and the prestige of gas. Truce or no truce the Industry has in this direction, we believe, a real duty to perform to the community, for in the low-consumption flueless heater the Industry has a simple and efficient appliance ideally suitable on all grounds, including that of safety, for giving that most desirable condition of bathroom comfort. The Industry should educate the public to the use of such low-consumption flueless gas heaters in bathrooms. By doing so it would earn the public's gratitude. It should lose no time in proffering this help and in thinking of the bathroom when considering comfort heating by gas.

And what of the truce? We quote from the current issue of an electrical contemporary: "Some more or less representative groups in the electricity and gas industries got together and concluded a 'truce' a short time ago. They agreed not to try to seize one another's customers for the duration of the war—a very good thing for the gas industry, which has been on the defensive for some years now. For our part we can see no harm in replacing an obsolescent gas system by up-to-date electrical methods, nor, for that matter, substituting an efficient gas system for an inadequate or unsatisfactory electrical arrangement. It is consequently without any qualms that we see the electricity supply industry going ahead in its drive for greater efficiency in industry and the home." We said in these columns last week that the truce has had a by no means stimulating effect on the Gas Industry, and we should like to witness a concerted drive by the Industry for greater efficiency in industry and the home. A bold face and a progressive policy are wanted and are justified. We repeat that what is wanted in more than one phase of the Industry's activities is a greater measure of confidence and a strengthening of the belief that the Gas Industry has an enormously important purpose to fulfil.

Road Tar Research

IN our first issue this year we said that one result of the war should be a keener appreciation by highway authorities of tar for the maintenance and construction of roads; and we pointed out that the need for prudent and well-directed expenditure on highways necessitates attention being given to the preservation of existing roads and cheap forms of surfacings for the construction of new roads. Tar is required not only for road making but for other purposes, such as camouflaging. Tarmacadam is needed which can be stored and if necessary used after long periods of time for emergency repairs of roads and landing grounds. There is need of improved types of surfacings capable of standing up to very heavy traffic. In the same issue we referred with satisfaction to the unabated work in wartime of the British Road Tar Association in applying scientific principles and standardization to road design, and to the publication by the Association of a most helpful booklet entitled "Road Problems in War"—a booklet packed with pertinent information.

More research work is being undertaken on the desirable properties and on the application technique of road tars than is perhaps generally realized, one of the most important lines of attack being an attempt to correlate tests on tar in the laboratory with its behaviour when applied on the road. This task is, to say the least, involved, for many factors come into play which affect the durability of road tar—such factors as atmospheric temperature, temperature of the road, humidity, ultra-violet light, type and volume of traffic, and, most important, method of application. At the moment we think that laboratory research into the properties of tar is in advance of what may be termed research on the craftsmanship of road-making. Even with the perfect

road binder success is possible only by accurate control during mixing and application. More failures are due to poor technique in using tar than to faulty methods in its preparation. It is, however, obviously desirable to continue with research aiming at standard laboratory tests by which the behaviour of tar in actual use on the roads can be confidently predicted without the necessity for carrying out long-term trials of the material under traffic conditions, and the amount of attention which is being paid to this aspect by the Road Research Board is to be welcomed.

The Report of the Board, which has just been published (H.M. Stationery Office 3s. 6d.), devotes considerable space to the findings of this correlation investigation in co-operation with the Chemical Research Laboratory, the Minister of Transport, and with various member firms of the British Road Tar Association. It constitutes the first stage in the investigations necessary for improving the specifications for road tars, the laboratory tests used being the present specification standard tests, drying and skin formation tests, solvent analysis, and outdoor weathering tests. To give an idea of the extent of the work we may mention that no fewer than 31 tars are being examined, 15 of a viscosity suitable for surface dressing and 16 of similar composition but of a higher viscosity suitable for thin surfacings. The tars include vertical retort, horizontal retort, coke oven, and blended high and low aromatic tars showing both good and poor durability by a laboratory durability test, tars blended with 10% bitumen, and tars fluxed with a special high-boiling tar oil. Obviously the tars have been selected to give as wide a range of durability as practicable; and the outcome of the work—it must necessarily take some time before the results can be properly assessed—should prove of great value.

Another investigation of considerable interest is that in progress on chlorinated rubber tars. Laboratory work has shown that chlorinated rubber dissolves in both high and low aromatic coal tars and pitches to form stable products. The major changes thereby effected are a large increase in the viscosity of the tar for each additional percentage of chlorinated rubber, a reduction of the temperature susceptibility compared with normal tars of equal viscosity, the imparting of elastic characteristics to the tar, and an improvement in the adhesive properties of the tar in the presence of water.

A road is judged by the success with which it maintains a good condition over a long period of years, during which progressive changes take place due to slow chemical and physical processes and to weather and traffic conditions. Experimentally, the difficulty is to compress these changes into a short enough period to enable new materials and processes to be judged in a reasonable time. The Road Research Board has examined the effect of accelerating traffic conditions by the development of road machines, and has attempted by a carefully controlled series of experiments to relate the results obtained on road machines with those obtained from actual road surfacings on a heavily trafficked trunk road. The conclusion indicated by the investigation is that it is not sufficient to test under conditions of accelerated traffic alone, since other factors in practice exert preponderating influences. In fact, temperature, moisture, and even the mere lapse of time may so alter the surfacings as to nullify the test results by simple traffic acceleration. The studies are, however, continuing, as we have indicated, in this attempt to assess the relative importance of these other factors and to examine them in relation to testing technique.

Progress in America

THE Gas Industry of the United States continued its record of progress and expansion during 1939. Its customers grew to the formidable total of 17,548,000, the largest number ever connected and an increase of 376,000 over the year 1938. Of these, 10,100,100 were served by manufactured gas—a number rather less than that of the British Gas Industry. Sales of manufactured gas for domestic uses, at 249,367,000,000 cu.ft., showed an increase of 1.8% for the year, while house heating sales registered a gain of 15.9%. Even greater was the increase in the industrial load—17.4%. New outlets for gas in industry are continuously being found, and the prospects for 1940 are very bright indeed.

The American Gas Industry is awakening to the potentialities of the gas engine load, and many gas engines are being installed for such purposes as refrigeration, electricity generation, water pumping, and air conditioning. The major portion of the load is being gained by natural gas, but the manufactured gas undertakings are developing the business also and adjusting their rates to bring gas within the competitive field. Diesel engines are readily convertible to gas, and we think that much could be done in this country in this direction. These units represent a good load building proposition not only when the rates of gas throughout the year are competitive with oil, but where low gas prices can be made available for part of the year, during the off-peak season, and gas can be used for such periods and oil on peak load. Under war conditions conversion from oil to gas becomes a matter of major importance. In America applications of gas engine power include installations where the exhaust gases are purified and used as inert gas for maintaining neutral atmospheres in heat treating furnaces or over varnish pots, and where the excess mechanical power generating capacity of engines at low loads is utilized in the generation and storage of both electrical and heat energy. We feel that the development of the gas engine load should be taken more seriously at this time in our own country. In saying this we are not forgetting the good work being put in by certain undertakings. Our point is that the effort should be more general.

Fuel in Science and Practice

IN 1921 the Coal Research Club was founded, and the following year saw the first number of *Fuel in Science and Practice*, which journal was published to give a wider field to the subjects of the Club's informal discussions. It was published as a supplement to the *Colliery Guardian* and was edited by the late Professor R. V. Wheeler and Dr. J. V. Elsden. Its success soon justified its publication as an independent journal, and the pages of its 18 volumes contain a wealth of important contributions to coal research. Following the death of Professor Wheeler, who had taken the principal part in guiding the destinies of the journal, *Fuel in Science and Practice* has entered a new phase, and while retaining its independent character it also becomes the research journal of the Institute of Fuel. Dr. R. Lessing has taken over the editorship, but the tradition of the publication will remain unaltered. The policy of the paper will be directed as in the past by the Coal Research Club. In a foreword to the new volume Sir Harold Hartley expresses the view that in addition to the journals in which the results of "pure" research are published *Fuel* will play a most useful part in affording a medium for the constant interchange of views between workers in the various fields—a view which we, too, share.

Nearly 1,600% Increase

Another striking instance has been brought to our notice of the way in which small undertakings can be helped by their bigger brethren.

Many of our readers will be familiar with the little town of Campden, in Gloucestershire, and its rivalry with its relatively near neighbour Broadway, in Worcestershire, as to which is the more picturesque. Up to the end of 1918 this Company sold approximately 3 million cu.ft. of gas. By 1934 sales had dropped to less than 1 million cu.ft., and in that year the Severn Valley Gas Corporation acquired it, connected it up with Cheltenham, and brought gas in bulk from that Undertaking. In the year 1939,

for which the results are just available, the Company has sold 16.8 million cu.ft., made a substantial profit, and paid a good dividend. This, we think, represents good service to the Industry.

True, a works making 1 million cu.ft. of gas has been shut down, but, on the other hand, production plant equal to about 19 million cu.ft. has been, or will be, installed at Cheltenham. Mains have been laid, a gasholder built, and upwards of £10,000 has been spent on meters, stoves, and appliances. In addition the Company obtained a five-year contract during 1939 for the street lighting, in keen competition with electricity.

Rations for Demonstrations

In view of the importance to the Gas Industry of adapting cookery demonstrations to the needs of the times the ruling of the Ministry of Food on the subject is interesting.

The position in regard to rationed foods for demonstration purposes is that special arrangements have been made for the supply of sugar on the basis of two ounces for each demonstration. The procedure is that application should be made to the local Food Office for form P.S.M. 1, on which to estimate requirements for each month from January to March inclusive. The Food Control Committee will issue a monthly permit (P.S.M. 2) to be presented to the usual supplier.

It is pointed out that at the present time butter can scarcely enter into demonstrations of cookery and this applies also to such cuts of bacon and ham as are included in the rationing scheme.

There are, of course, certain varieties which are free from sale restrictions such as chaps and chawls, fore and hind legs, knuckles, fore hocks, gammon hocks and the parts of the shoulders known as "picnics," as well as cooked ham or gammon.

Personal

At a presentation to Mr. R. POWELL, before his departure from Colwyn Bay to take up the appointment of Engineer and Manager to the Llangollen Gas Company, Mr. H. Blythe, Engineer and Manager of the Colwyn Bay Gas Department, said that Undertaking held the distinction of having supplied the two youngest gas engineers in the country. The first was Mr. S. T. Jones, who, a short time ago, at the age of 26, was appointed to the chief executive position at Oswaldtwistle, and now Mr. Powell, who had secured his appointment at the age of 28. Mr. Powell was presented with a wristlet watch.

* * *

Mr. J. F. MILLAR has been elected Chairman of the Stirling Gas Light Company.

* * *

Mr. G. J. JACKSON, Managing Director of the Woodall-Duckham Company, has returned safely to this country after a voyage to and from South Africa, where he made arrangements for putting in hand the construction of the large installation of coke ovens and by-product plant, the order for which the Company has recently received from the South African Iron & Steel Industrial Corporation, Ltd.

* * *

Major G. HARRISON has been elected Chairman of the Board of the London Press Exchange, in succession to the late Mr. R. J. Sykes. Major Harrison will continue to hold the office of Managing Director of the Company, which he has held since September, 1930.

Obituary

Mr. ROBERT JOHNSTON CARRUTHERS, of Ashby, a Director of the Ashby Gas Company, died on Jan. 24, aged 89.

* * *

The death has taken place at Saltburn, Yorkshire, of Dr. JOHN A. ROELOFSEN, General Manager of Messrs. Dorman, Long & Co.'s by-product and distillation plant at Port Clarence. He was 69 years of age and was a Vice-President of the British Road Tar Association, past-President of the Association of Tar Distillers, and Chairman of the Creosote Producers' Association.

* * *

Professor Sir GILBERT MORGAN, D.Sc., F.R.S., F.I.C., formerly Director of Chemical Research under the Department of Scientific and Industrial Research, died on Feb. 1. During the 13 years he held the appointment he built up an asset of the greatest value to the nation. Among the many investigations undertaken were those relating to low temperature tar, high pressure chemistry, the corrosion of metals, and water pollution.

The death occurred on Jan. 25 of Mr. HENRY A. WATSON, a Director of the Mirfield Gas Company since 1908, and Chairman since 1915. He was 87 years of age.

* * *

We have to record the death on Feb. 3, at the age of 67, of Mr. SYDNEY FRANCIS, M.B.E., A.M.I.Mech.E., Engineer and Manager of the Clacton Urban District Council's Gas and Water Undertaking. He was at business and in his customary good health a few days prior to his death.

Mr. Francis started his career under articles to Mr. John Dixon, the world renowned engineer who brought Cleopatra's Needle to London, and first became associated with the gas and water business when he joined J. & H. Robus—a firm of gas and water works engineers—during the later years of the last century. In 1899 he was appointed Gas and Water Engineer and Manager to the Clacton Urban District Council, who at that time had just purchased the local gas and water undertaking from the Clacton Gas and Water Company. Consequently, Mr. Francis had been Engineer of this Undertaking throughout the whole period of just over forty years that it has been owned by the Urban District Council. In addition to his duties at Clacton, he was for some years Managing Director of Moffats, Ltd., gas lighting engineers.

During the time Mr. Francis was at Clacton the output of the Gas Undertaking has grown from about 25 million cu.ft. to approximately 230 million cu.ft. of gas per annum. He was responsible for all the works extensions and in 1932 installed vertical retorts and arranged for the Clacton Works to supply all the gas required by the Frinton and Walton Gas Undertaking of the Tendring Hundred Waterworks Company.

Mr. Francis was Founder-President of the Clacton Rotary Club and was Superintendent of the Clacton Division of the Essex Special Constabulary from 1914 to his decease. He was awarded the M.B.E. in the New Year's Honours List of 1927 following his work in the organization of the Special Constabulary over a large area in Essex during the War of 1914-18 and the General Strike of 1926.

He leaves a son and two daughters, and the family connexion with the Gas Industry is maintained by his son, Mr. Stanley Francis, who is the Northern technical representative for the Woodall-Duckham Company.

The "JOURNAL" Calendar and Directory

The undernoted changes in the "JOURNAL" Directory were notified too late for inclusion in the 1940 Edition, which should now be in the hands of our readers. It is proposed to continue our practice of publishing in the first issue of the "JOURNAL" each month a list of the various changes of which we are advised in order that readers may keep the particulars contained in the Directory up to date.

Page 18. CLACTON. S. Francis, E. & M., deceased.
" 18. COLCHESTER. W. W. Townsend, MD. & E., deceased.
" 30. GUISBOROUGH. T. E. Furniss, E., M., & S., deceased.
" 36. HULL. T. W. T. Hammerton, M.& S.; B. Stonham, E.
" 40. LEAMINGTON. Capital, 106,220; Make, 495; Sales, 457; % ind., 15; Consumers, 11,717; Oil Gas'd, 3; Prices, 10.5d., 12.16d. *sl.*
" 42. LLANGOLLEN. R. Powell appointed E. & M.
" 44. MALMESBURY. T. L. Tallentire, E. & M.; W. L. Davey, RM.; H. G. Gower, S. Consumers, 601; Coal carbonized, .1,159; Coke made, 472; for sale, 319.
" 52. PEMBROKE. L. W. Nuttall, MD. & S.; D. W. Rees, E. & M.
" 66. STOCKPORT. R. Willacy, S. & Acct., retired.
" 66. STONE. A. Winton, S., appointed Acting M. *vice* J. R. Heath, retired.
" 84. DARVEL. J. Cochrane, M., deceased.
" 88. KILMACOLM. J. Naismith, M., deceased.
" 140. STEPNEY. A. E. Campbell, Borough Electrical Engineer, vice D. G. Sandeman.
" 150. The publishers regret that reference to the Lancashire & District Coke Association was inadvertently omitted from among the "Kindred Organizations." This body is similar in character and scope to the London & Counties and other coke associations which have now been functioning for some considerable time. The *Offices* are at 38, Kennedy Street, Manchester, 2. *Chairman:* J. D. Ashworth (Blackburn); *Vice-Chairman:* J. H. Cadman (Manchester); *Secretary and Treasurer:* W. Stephenson.

Letter to the Editor

The Coal Industry

SIR,—Dr. Foxwell describes my letter as a "stereotyped answer." When the Germans asked: Where is the Ark Royal? we replied truthfully that she was on her job. When the question was repeated *ad nauseam* we could only give the same answer, which thus became "stereotyped." The important thing, however, was not whether it was "stereotyped," but whether it was accurate. So with this question of profits in the coal industry. Dr. Foxwell did not have the figures for the last three years. I gave them to him from the Mines Department Publications. They are strictly factual and therefore *must* be "stereotyped," for if he asks me again next year I shall have to give him the same figures.

I added as a matter of interest that in the ten years 1928-1937 the industry had supplied over 2,000 million tons of coal at an average profit of 1½d. per ton. Such a profit is admittedly inadequate, but Dr. Foxwell ignores it and its necessary implications. Instead, he accuses the industry of "regarding the world as its milch cow," simply because the intensive competition which enabled some consumers to buy below cost of production has been stopped, and all must now pay an economic price. The effect of this change is shown in the figures I gave for profits for the years 1936-37 and 1938. The steady improvement in the figures is the justification for the selling schemes, but the profit of 1s. 1d. per ton for the year 1938 is still too low for an industry which is dependent on a wasting asset.

I cannot agree that the 1938 figures give no indication of the effect of price increases on profits. The selling schemes came into operation on Aug. 1, 1936. Existing contracts had then been running for some time and there were still seventeen months to go before 1938 began. The great majority of the contracts had expired before Dec. 31, 1937, and only a relatively small proportion of the output of 1938 was affected by long-term contracts made at low prices.

Dr. Foxwell dislikes the average method of showing profit or loss, but a basis showing the profit or loss per ton of coal sold is surely a reliable guide as to the position of the Industry as a whole. If he wants it in greater detail the Mines Department gives the figures for each of nine districts. Thus in 1938 it ranged from 1.89d. per ton in South Wales to nearly 2s. in South Derbyshire, Leicestershire, Cannock Chase, and Warwickshire. If he wants still further detail, most of the undertakings producing coal are public companies, and the particulars he mentions, such as dividends, &c., are public property as accessible to him as to me. I am sorry I cannot agree to compile a list for him.

Dr. Foxwell was good enough to rely on my book for his figures of output, &c. If he will consult the appendices again, he will see he is in error in stating that after the last War "interest in thermal efficiency caused the output of the collieries to drop like a stone." Home consumption did not drop like a stone at all, for in 1920 the output was only 57,000,000 tons less than in 1913, although exports had decreased by 55,000,000 tons. In 1937, despite the interest in thermal efficiency, and the tremendous reduction due to improved methods of utilization, the amount of coal consumed in the home market was greater than at any period in the history of the Industry.

Coal mining is a productive and not a service industry. I am therefore sorry I cannot agree that it is desirable to put in in the same category as gas, water, or electricity undertakings. I can only hope Dr. Foxwell realizes the full implication of this proposal, for if applicable to coal it is equally so to other basic industries, and he must know where that would lead him.

Coal mining is a productive and not a service industry. I am therefore sorry I cannot agree that it is desirable to put it in the figure. A "cheap and abundant" supply, however, was made a fetish after both the theory and the practice had outlived their day. The new method places the industry on a sound economic basis, and ensures all-round justice by depriving a minority of buyers of an unfair privilege too long enjoyed. It is natural the latter should resent the deprivation, but they must realize that both capital and labour are entitled to fair play in this, the greatest of all our industries.

I should like to see the relations between the coal industry and the Gas Industry improved, but I am afraid this will remain difficult until the leaders of the latter recognize and acknowledge that miners are entitled to fair wages and colliery owners to a fair profit.

Yours, &c.,
J. P. DICKIE.

15, Pollards Hill South,
London, S.W. 16.
Jan. 30, 1940.

Producer Gas For Motor Transport

Report of Committee Published

As we go to press we have received the Report of the Committee on the Emergency Conversion of Motor Vehicles to Producer Gas.

The Chairman of the Committee is Sir Harold Hartley, C.B.E., M.C., F.R.S., Chairman of the Fuel Research Board of the Department of Scientific and Industrial Research, and technical experts from several important road transport operating companies and from the appropriate Government Departments are represented on this Committee.

The Report contains a general account of the research work which the Committee has supervised, and an illustrated description of the producer and trailer unit designed by them. It also includes information on the problems of cooling and filtering producer gas, notes on the operation of producer gas vehicles, a specification of the suitable fuels, and particulars of the fuel supplies available.

It was recently announced that firms interested in the manufacture of the producer should communicate with the Director, Fuel Research Station, Blackwall Lane, East Greenwich, S.E.10. A large number of enquiries have already been received, and about twenty-five firms have been granted licences and are taking active steps to manufacture equipment conforming with the Committee's design.

Copies of the Report can be obtained (price 9d.) from H.M. Stationery Office or from any bookseller.

Forthcoming Engagements

Feb.

13.—N.G.C.—Central Executive Board, 2.30 p.m.

13.—I.G.E.—Finance Committee, 2 p.m.; Membership Committee, 2.30 p.m.

13.—Gas Research Board.—Methane Panel of Joint Committee on Complete Gasification under Pressure, Gas Industry House, 10.30 a.m.

15.—Gas Research Board.—Drafting Panel of Council, Gas Industry House, 11 a.m.

15.—Fuel Luncheon Club.—Connaught Rooms, 12.40 p.m. After Luncheon Address by Dr. Franz Kind.

16.—B.C.G.A.—Annual Meeting of Members in Scotland, Central Station Hotel, Glasgow, 2.30 p.m.

16.—Chemical Engineering Group.—Meeting in Rooms of Chemical Society, Burlington House, W.1, 2.30 p.m. Paper by Mr. B. N. Reavell and Dr. G. E. Foxwell, on "The Chemical Plant Manufacturer in Relation to Chemical Industry."

19.—L.C.C.A.—Finance Committee, 10.45 a.m.; Executive Committee, 11.15 a.m.; Central Committee, 2.15 p.m.

20.—I.G.E.—Gas Education Executive Committee, 11 a.m.; Gas Education Committee, 2 p.m.

22.—Institute of Fuel.—Meeting at Burlington House, Piccadilly, W.1, 2.15 p.m. Paper by S. Thomson, "Modern Gas Storage."

24.—Manchester and District Juniors.—Meeting at Manchester. Address by Sir Frederick West.

24.—Yorkshire Juniors.—Meeting at Bradford. Paper by S. H. Stokes (Elland), "Economic Utilization of Unscreened Coke Breeze."

29.—S.B.G.I.—Meeting of Emergency Committee, Crown Hotel, Banbury, 2 p.m.

March

1.—Gas Research Board.—Joint Committee on Complete Gasification under Pressure, 2.30 p.m.

5.—Gas Research Board.—Council Meeting, Gas Industry House, 2 p.m.

11.—I.G.E.—Finance Committee, 1.45 p.m.; Membership Committee, 2.15 p.m.; General Purposes Committee, 3 p.m.

12.—I.G.E.—Council Meeting, 10 a.m.

14.—Gas Research Board.—Refractory Materials Joint Committee, 2.30 p.m.

15.—I.G.E.—Liquor Effluents and Ammonia Committee, 11.30 a.m.

15.—Gas Research Board.—Joint Research Committee, 2 p.m.

19.—I.G.E.—Gas Education Executive Committee, 2 p.m.

April

19.—I.G.E.—Chairmen's Technical Committee, 2.30 p.m. (Not Feb. 19 as stated last week.)

News of the Week

New Gas Showrooms are shortly to be opened at Walkden by the Salford Corporation Gas Department.

After Investigation, a Joint Gas and Electricity Committee of the Morecambe and Heysham Town Council has decided that it is impracticable to combine the two undertakings under one engineer.

Negotiations are to be Opened by the Accrington and District Gas Board with regard to obtaining from the Lancashire Foundry and Coke Company a supply of gas in excess of the present contract quantity of 2½ million cu.ft. per day.

An Outbreak of Fire occurred on Jan. 31, at the Falkirk Gas-Works. It was subdued within an hour, but the brigade were engaged overnight in clearing the debris. The fire broke out in a block of buildings used as a gas meter repair shop.

The New Gas-Works erected by the Blackpool Corporation Gas Department at Marton are expected to be in production by June. The completion of these works, which are intended to serve the Poulton-le-Fylde district, has been delayed by the war.

Proposals to Amalgamate the gas and electricity undertakings as a Power and Light Department have been discussed by a special committee of Lytham St. Annes Corporation. The Town Clerk, Boro' Treasurer, and departmental officials are to prepare a comprehensive report for consideration by the Council.

Ruston & Hornsby, Ltd., of Lincoln, have acquired the share capital of Davey, Paxman & Co. (Colchester), Ltd., oil engine builders and boiler manufacturers. The products of the Companies are complementary, and the object of the fusion is to enlarge the joint range of manufactures, to the advantage of both businesses. Davey, Paxman & Co. have an authorized capital of £100,000, of which £70,000 has been issued.

Restriction of Hire-Purchase business in both gas and electrical appliances to persons whose financial position has been found satisfactory by the Treasurer's Department is the recent decision of the Shipley Urban District Council. Canvassing for this class of business is to be confined to the Council's own staff, and no apparatus costing less than £2 10s. will be offered on hire-purchase terms. The initial payment on all hire-purchase goods will be 15% of the cash price.

In a Report to the January meeting of Scunthorpe Town Council the Gas Manager mentioned that repairs are urgently needed to the retorts at the gas-works, and in consequence of the increased load during recent years the repairs cannot be effected without the completion of the original scheme which was sanctioned in 1924. It is estimated that the completion of the scheme would cost £8,400 and the repairs alone £1,800. Before applying for loan sanction, however, the Council decided that enquiries should be made as to obtaining coke oven gas from one of the local steelworks, and the Gas Manager was instructed to go into the matter.

Tenders for Re-setting two beds of six horizontal retorts are being sought by the Cockermouth Urban District Council Gas Department.

For the Erection of a New Holder, the Birkenhead Gas Committee have obtained consent from the Ministry of Health to borrow the sum of £71,500.

It is Estimated that the income of the Manchester Corporation Gas Department for the year 1940-41 will be £1,216,800. Expenditure, including the provision of new plant, is computed at £1,070,750. This will leave a balance which is considered sufficient to meet interest and loan charges.

Notice is Given by the Derby Gas Light and Coke Company that as and from May 1, 1940, it is intended to alter the declared calorific value of the gas supplied by the Company in the area formerly supplied by the Langley Mill and Heanor Gas Undertaking from 440 B.Th.U. to 500 B.Th.U.

Replying to a Question in the House of Commons, the Secretary for Mines stated that the low-temperature carbonization plant at Warntarw Pencoed in South Wales has started up. This is a "Coalite" plant by Messrs. Low Temperature Carbonization, Ltd., and 72 of the 144 retorts are understood to be at work, the remainder to follow shortly.

The Annual Whist Drive and Dance of the Exeter Gaslight and Coke Company's Athletic and Sports Club was held at the Rougemont Hotel. The event was organized by a social committee under the General Secretary of the club, Mr. E. C. Loynes. Mr. F. Allen acted as M.C. for the whist, while Mr. W. Daw acted in a similar capacity for the dancing which followed.

A Meeting has been Held between representatives of the Sunderland Gas Company and the Sunderland Corporation, Sunderland Rural Council, and the Bolton Urban Council to discuss the Company's request for a contribution towards the maintenance of public lighting services during the black-out. The representatives of the local authorities are reporting back to their Councils.

The Next Meeting of the Fuel Luncheon Club will take place at the Connaught Rooms, Great Queen Street, Kingsway, W.C.2, on Thursday, Feb. 15, at 12.40 for 1.10 p.m., when the after Luncheon Address on "Home Refining and National Economy" will be given by Dr. Franz Kind (Manchester Oil Refinery, Ltd.). The Chair will be taken by the President, Lt. Colonel W. A. Bristow, M.I.E.E., F.R.A.S.

Darlington is Among the First towns in the North to put into operation a modified street lighting scheme by gas. When the Gas Department received the first three of the special lamps last Friday they immediately fixed them on lamp-posts in Priestgate, and the result was satisfactory. Mr. A. E. Ruffhead, the Gas Engineer, states that it is intended to have modified lighting in all the principal streets of the town, and larger quantities of lamps are expected to arrive in a week or two.

Good Publicity for Coke

An attractive leaflet, in which good use has been made of colour printing, has been issued by the Coke Producers' Federation, Ltd., whose headquarters are at Sheffield. While the membership of this Federation is at the moment confined to 22 colliery and coking concerns, it is understood that the organization works in close collaboration with the Midland Coke Association, which, of course, also embraces the gas coke interests.

It may be assumed, therefore, that this well-produced piece of publicity material will serve a useful purpose in stimulating the sales of coke generally in the area. The members of the Federation have a combined output exceeding 3,000,000 tons of Yorkshire coke per annum, which is available not only to meet the requirements of the iron and steel industries but also all kinds of domestic and industrial uses. The Federation has set up a Technical and Advisory Bureau at Norfolk Chambers, 9, Norfolk Row, Sheffield, which is available freely and without obligation to promote the effective use of coke, and to assist the consumer to obtain increased efficiency and reduced costs, as well as to ensure that the use of coke is developed along economic and scientific lines. The technical staff of the Bureau will investigate and advise on any problems relating to contemplated or existing installations, and anyone experiencing difficulty in either the selection or use of fuel-burning appliances is invited to take advantage of these specialized services.

The principal subject of the leaflet is the application of gravity-feed coke boilers to central heating and hot water supply, both domestic and industrial, and the subject matter is supported by striking colour illustrations and the appealing slogan "Once-a-Day Stoking."

A War Time Cookery Book

Over 370 tested recipes for all meals, suitable for large or small families, are included in the *Daily Express* "War-Time Cookery Book," published at one shilling. The object of the book is to show how to prepare appetizing dishes from inexpensive foods and left-overs, to use plentiful foodstuffs as substitutes for scarce and costly produce, to ensure full nourishment without extravagance, and to save money and avoid waste by careful kitchen management. The recipes have been prepared expressly for gas cookery, the appropriate thermostat readings being given for all those requiring exact heat control.

There are practical suggestions for making the most of the rationed foods and for the substitution of non-rationed foods without detriment either to nourishment or attractiveness. Useful hints are also given with regard to fuel economy and the use of the tier steamer, the casserole and the hay box. The book is eminently suitable for demonstration purposes, proving as it does that war-time cooking and catering need not be unduly difficult and that interesting and attractive dishes can be created from ingredients which might have been treated with disdain in happier times.

Iron and Steel Control

The Control of Iron and Steel (No. 4) Order, 1939, the provisions of which, so far as the Gas Industry is concerned, were outlined in the "JOURNAL" of November 8 (page 285), is superseded by the Control of Iron and Steel (No. 6) Order, 1940, which came into operation on Feb. 1. Maximum prices have been revised and the position in regard to contractors and sub-contractors of the exempted persons mentioned in the former Order has been clarified. A contractor or sub-contractor can acquire material without licence only for the express purpose of using the material directly in fulfilment of a contract with an exempted principal or of a sub-contract under such a contract. Exemption from licence of purchases of material required for A.R.P. has been limited to purchases of material required to enable the purchaser to fulfil an obligation under the Civil Defence Act, 1939. The list of materials which may be purchased without licence in small quantities has been drastically revised and curtailed.

Manchester and District Juniors

At a General Meeting of the Manchester and District Junior Gas Association, held in the Demonstration Theatre of the Manchester Corporation Gas Department on Saturday, Jan. 27, the decision of the Council to hold meetings during the war period was confirmed.

It was also unanimously approved that Mr. H. Platt (Bolton) should continue in Office as President, along with the other Officers and Members of the Council, until conditions are more settled.

A general discussion took place on technical problems and difficulties arising from war conditions. The President outlined the precautions necessary on a gas-works for the safety of plant and apparatus. He explained that the Government were giving financial assistance in respect of approved A.R.P. schemes. The discussion covered such diverse subjects as "starlight" street lighting, directional signs, benzole recovery, and gas for war industries and transport purposes.

Although the attendance was much below the average, the enthusiasm of the members was reflected in the general tone of the meeting.

The next meeting is to be held on Saturday, Feb. 24, in the Manchester Showrooms, when Sir Frederick West will give a Cinematograph lecture on his world tour.

Results at Durham

The profits of the City of Durham Gas Company for the year 1939 show a decrease of £2,003 when compared with those for the preceding twelve months, due mainly to the falling off in revenue consequent upon the cessation of public lighting and the exercise of economy by domestic consumers. In addition to this, the cost of coal continues to rise (expenditure under this head being £537 more than a year ago). An advance in wages has taken effect from January of this year. In view of all these circumstances, it was necessary to increase the price of gas by 1d. per therm as from the December meter readings. During the year negotiations have taken place for obtaining the whole of the Company's requirements of gas in bulk from coke ovens, and it is anticipated that an agreement will shortly be entered into with the Mid-Durham Carbonization Company, Ltd., for the purchase of gas from their ovens at Pelton Fell. Application is being made to the Board of Trade for a Special Order giving powers to lay the necessary mains. The dividends for the year are 7½% on the original capital, 5¼% on the ordinary capital, and 4% on the preference capital. The sum of £3,164 is transferred from the Reserve Fund, and there is written off £4,365 value of dismantled gasholder and £3,581 cost of alterations to premises.

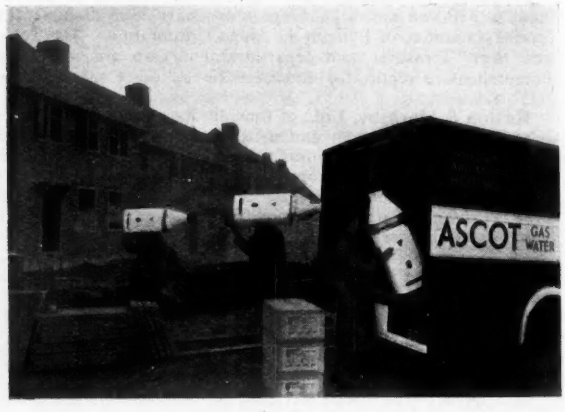
Scrap Metal Campaign

The iron and steel scrap campaign which yielded about 80,000 tons of scrap metal from the fringes of industry during the last two months of 1939 is to be intensified and to become nation-wide, as in France. In the first phase of the canvass some 150,000 manufacturers, including gas undertakings and makers of gas fittings, meters and stoves, were circularized and as a result additional scrap was secured that would have taken ten or a dozen ships to bring to our shores if it had had to be imported.

Speaking at a Press conference at Steel House, Westminster, on Monday, Major H. E. Crawfurd, Chairman of the National Federation of Scrap Iron and Steel Merchants, said the success of the experiment had convinced those charged with the control of the manufacture and distribution of iron and steel in this country that an intensification and extension of the effort would lead to still more solid results. It was intended to follow up the initial effort and to secure that all the waste metallic produce of British industry went to feed the works from which it originally came. Plans had been made for the recovery of scrap metal from agriculture, and it was also intended to tackle the immense problem of domestic and household scrap in towns and urban districts. The headquarters of the campaign would be at 427, North West Wing, Bush House, Aldwych, W.C.2.

It was stated during the conference that the Gas Industry had responded very well to the appeal, and that, as a whole, the Industry was handling its scrap metal problems in a successful manner.

Hot Baths for the Army



A delivery of 150 "Ascot" multi-point gas water heaters to a new housing estate. This scheme involves 900 houses and flats in which, until peace returns, the Forces will enjoy unlimited baths and hot water for all purposes, with the help of the Gas Industry and the "Ascot" instantaneous water heater. This is only one of the innumerable National Defence jobs featuring "Ascots," of which many thousands have already been installed. The gas supply was laid by the South Metropolitan Gas Company.

Glasgow Coke Oven Gas Supplies

At a meeting of Glasgow Town Council on Feb. 1 it was admitted that the Gas Department was experiencing some difficulty in meeting demands. Reference was made to a statement in the local Press to the effect that the Government had refused to sanction capital expenditure on extensions to the Provan Gas-Works while supplies of coke oven gas were available.

Councillor Thomas Wilson, J.P. (Convener of the Gas Committee), said that the Scottish Home Department has asked the Corporation to explore the possibilities of meeting their needs from local coke oven gas. A reply had been sent stating that the Corporation was considering an offer of coke oven gas, but that reconstruction at Provan Gas-Works was also necessary to meet the needs of industrial consumers, especially those engaged on work of national importance. Councillor Wilson stated that the total amount of coke oven gas taken by the Corporation during their ten years' contract with Messrs. Nimmo was over 7,250 million cu.ft., and 500,000 tons of coal would have been used to produce this amount. The refusal to take more coke oven gas was due to a decision of the Corporation, and the Gas Committee could not be blamed for the present emergency. The pressure of gas had to be reduced because of the low yield from weathered coal out of stock purchased in 1926.

New Gas Showroom at Yatton

The opening of a new Gas Showroom at Yatton marked a further step in the progress of the Clevedon and Yatton Gas Company in serving the interests of the district. It was formally opened on January 16 by Mr. Thomas Burdge, C.C., Chairman of the Parish Council, and at the ceremony Colonel Sidney Keen, D.S.O. (Chairman of the Company), presided, following which there was a luncheon.

THE building is situated on a corner site, and is built and faced with Clevedon bricks. The site has a steep rise, but advantage has been taken of this to increase the window display by a series of landings which have virtually made the whole showroom a single display window.

On the ground floor are arranged a showroom 34 ft. by 30 ft., and a demonstration room 30 ft. by 15 ft. On the upper floor is a Board Room and living apartments for the caretaker.

Among those present at the opening ceremony were: Messrs. W. H. Bennett (Deputy Chairman), J. Urquhart and A. E. Whitcher (Directors), J. Harger Pye (Managing Director), E. G. Cole (Secretary), S. B. Jones (Assistant Engineer), and W. J. Hurn (District Superintendent), J. R. W. Alexander, Alderman H. Butt, J.P., C.C. (Chairman, Weston-super-Mare Gas Company), Mr. J. Taylor (Engineer and Manager, Weston-super-Mare Gas Company), Sir Ambrose and Lady Elton, and Lord and Lady Teignmouth.

Improved Service

Colonel Keen, in welcoming the guests, reminded them that when the Yatton Gas Company was formed many years ago, gas was used for lighting only. Matters had changed entirely since then. When it was found necessary to increase the supplies because the old Company's works were hardly adequate, the Yatton Gas Company's Directors approached the Clevedon Company with a view either to amalgamation or absorption. Now, as a joint Company, were supplying the needs of Yatton as well as Clevedon, to the satisfaction of everybody, he hoped. They had spent a good deal of capital in increasing the size of the mains that were urgent, and they would do more in that direction later, as soon as the war was over. They had erected a large gasholder which provided ample reserves and increased the pressure. They had left the showroom until the last, because they wanted to be sure they were able to meet all the needs. Referring to the showroom, Colonel Keen said the Directors were pleased and not a little proud of it, and they hoped customers would make full use of it, as the Company were anxious to live up to its motto of "Service."

Formally declaring the new showroom open, Mr. T. Burdge expressed his gratitude for the building which had been erected. They had selected what he thought was the very best site in Yatton and erected on it an attractive building, of which the Company could be proud. He hoped the public response would be such as well to justify the Company in their outlay.

The Rev. W. N. Kempe (vicar of Yatton) in moving a vote of thanks to Mr. Burdge, endorsed all that Mr. Burdge had said regarding the showroom, which definitely added to the amenities of a small but growing village. He hoped that the Company would see an ample return for their enterprise, which deserved every support.

Luncheon Speeches

The ceremony over, the assembly inspected the showroom before adjourning to the Railway Hotel, where luncheon was served.

Colonel Sidney Keen, who presided, submitted the loyal toast, and also proposed "The Guests," to which Mr. Burdge replied.

Mr. J. Harger Pye, proposing "The Architect and Builder," said: "We shall welcome everyone, and I hope they will tell us their difficulties. We hope to have the opportunity of telling the people what gas can do for them. Even in wartime we shall be able to render good and faithful service." Three years ago, said Mr. Pye, they started to train men specially for work in that parish. All the men who had been trained were now serving in the armed forces, and they had lost something like 50% of their staff.

Mr. R. C. Counsell, submitting an additional toast of "Prosperity to the Clevedon and Yatton Gas Company," referred to the improvement in the gas pressure since the old Company, of which he was Chairman, was taken over, the introduction of a gasholder for emergency purposes, the reduced price of gas, and the efficient service which had been rendered to the consumers. He was sure the Company had done everything in a prompt and satisfactory manner.

Of Benefit to Consumers

Mr. W. H. Bennett, acknowledging the toast, said that in the same way that the Directors of the Yatton Gas Company thought they could benefit the residents of Yatton by combining with their neighbours, Clevedon, so the Clevedon and Yatton Gas Company, in their wisdom, a few months ago thought fit to join the Association which was called Associated Gas and Water Undertakings. It was not a Company organized from London with the intention of getting all they could from the gas consumers. It was organized by people who had been in the Gas Industry all their lives, and knew it was possible to bring about economies by joint working and co-ordination. He was sure the joining of the Company with that body would assist in keeping down prices of gas if it was possible.

A presentation concluded the proceedings, when the Chairman handed Mr. Burdge a silver salver as a memento of the occasion.

R. & A. Main's Economy Recipes

A new booklet which R. & A. Main, Ltd., are offering free to the public through their national advertising is entitled "Gas Cooking in War-Time." They describe it as a selection of "economy" recipes and hints on saving gas, and a glance at the contents reveals at once that it constitutes yet another genuine service by the Gas Industry to the housewife. It is of handy size, and, as the publishers explain, it is neither exhaustive nor so intended. Yet the recipes it contains number nearly sixty, and they are of the real utility type, completely avoiding such tiresome suggestions as "throw in a dozen fresh eggs" or "melt 4 oz. of butter." There is an interesting section on "cold-oven-start" cookery which will appeal to the frugally minded housewife, explaining which dishes can, and which cannot, be treated in this way. "Instead of Meat" dishes is a section which will also undoubtedly be popular in days to come. Messrs. Main's new production is undoubtedly a valuable addition to the Industry's war time literature.

Recent Views on Factors Affecting Flame Velocity

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Communication No. 221 of the Institution of Gas Engineers

I SUMMARY

In this Paper a brief account is given of recent theories of flame propagation, and the possible effects thereon of chemical sensitization are discussed. While many of the problems associated with aerated Bunsen flames are related simply to physical causes, it appears possible that others may be more related to chemical factors. There appears to be a need for further investigation into some of the chemical issues raised, and among other things it is proposed to carry out work of this character at Leeds University.

II INTRODUCTION

The aerated Bunsen flame is well known to consist of a double cone structure. The inner cone is an explosion flame, a balance existing between the rate of supply of the explosive mixture, composed of gas and primary air, and the rate of flame travel through it in the opposite direction. The outer flame is a non-aerated or diffusion flame, its dimensions and intensity depending on the composition and temperature of the gases leaving the inner cone, and the rate of diffusion of its combustible constituents into the surrounding air.

The stability of the inner cone depends upon a number of variable factors, including the air-gas ratio, which is controlled by the supply pressure, its specific gravity and the design of the burner, e.g., gas orifice, air inlet, etc. The air-gas ratio influences the rate of flame travel through the particular primary mixture obtained; and aerodynamical influences associated with the manner of gas flow from the burner orifice also call for consideration. It is widely agreed that rate of flame travel is the most important factor in regard to the general performance of an aerated burner. Apart from the question of varying air requirement for complete combustion, the speed of flame through corresponding explosive mixtures with air of the individual combustible constituents of a town gas varies very greatly, descending roughly in the order, hydrogen, ethylene, carbon monoxide, methane, higher hydrocarbons. Moreover, it is not possible—for reasons which are given later—to calculate from a knowledge of flame-speeds characteristic of the individual gases, the flame-speed relating to a mixture with air of a blend of combustible gases (town gas). This is one reason why recourse has been made to the use of standard test burners which provide as a working index of the so-called combustion characteristics of a particular supply either (*a*) the air-shutter opening for a given inner cone height (A.T.B. Number) or (*b*) the inner cone height observed with a fixed air port (Hofsäss).

The character of the outer cone does not depend directly on the composition of the particular supply. It is well known that when combustibles are burnt with defect of oxygen, as in the inner cone, the combustible products consist essentially of carbon monoxide and hydrogen together with some steam, CO_2, and nitrogen; this is due to the operation of such reversible processes as $CH_4 + H_2O \rightleftharpoons CO + 3H_2$, $CH_4 + CO_2 \rightleftharpoons 2CO + 2H_2$ and $CO + H_2O \rightleftharpoons H_2 + CO_2$ at the temperatures attained. Except in special circumstances as, for example, when the burners are overloaded or are designed to burn theoretical mixtures, the outer cones of all flames therefore consist mainly of diffusion flames of hydrogen and carbon monoxide admixed with inert gases.

Many of the difficulties associated with the varying combustion characteristics of town gas will only disappear as supplies become more standardized. The time is hardly ripe, however, to discuss in detail the possible manufacturing methods of the future; nor yet, if there were a wide choice of equally economic supplies, would there be agreement upon the best selection from them. Some of these difficulties, but not all, may disappear with the increasing use of non-aerated flames; yet countless appliances will probably always operate with Bunsen flames.

It is not easy to assess some of the statements which have been reported from time to time in regard to problems relating to combustion characteristics. None the less there appears to be evidence that some supplies, perhaps those of high unsaturated hydrocarbon content, are prone to abnormal behaviour, particularly in certain appliances. To state a case, it may happen that appliances similarly adjusted for the same gas behave differently when used on another supply. The differences in performance may be attributable to either (*a*) physical factors or (*b*) chemical factors. The former might involve differences in (i) the heating up of the burners, (ii) the aerodynamical state of the supply, or (iii) aeration. The chemical factors influencing the flame-speeds might be affected by the operation of a number of causes, which it is the purpose of this Paper to consider.

III THE MECHANISM OF FLAME PROPAGATION

According to the thermal theory of flame propagation advanced by Mallard and Le Chatelier in 1881, flame was regarded as being propagated through an explosive mixture by virtue of the heat which was conducted from the burning layer to the unburnt layer immediately adjacent to it, this heat being sufficient to raise the unburnt gas to its ignition temperature; some of the heat of combustion from this layer was passed on to the next and so on. Thus, according to this view the rate of flame propagation was directly related to the flame temperature and the thermal conductivity of the mixture, and was inversely proportional to the assumed ignition temperature and the heat capacity of the unburnt gas. In spite of various attempts, e.g., that by W. Nusselt[1] to bring the theory up to date by taking account of temperature gradients, etc. it has now fallen into disfavour, for no account is taken of certain relevant factors referred to later; moreover, it is not completely supported by experimental evidence. Indeed, the conception of an ignition temperature as used in the theory is now known to be without scientific significance.

The Mechanism of Chemical Reaction

The classical view of Arrhenius indicated that the rate of slow combustion in any particular case was controlled by temperature; for the number of molecules whose energy exceeded the activation energy E requisite for participation in the reaction, was approximately proportional to $e^{-E/RT}$. According to this view, raising the temperature speeded up reaction in proportion to the increase in the number of such activated molecules, and an ignition temperature was defined as that temperature to which the medium must be raised so that the process becomes sufficiently rapid for the heat lost from the system by conduction to be more than counterbalanced by the rate at which it is evolved by the reaction.

To-day many phenomena are recognized which have tended to invalidate the universal application of this simple

thermal view. Reference need only be made here to the following:

(*a*) The disproportionate influences of mere traces of foreign bodies which act either as "inhibitors" or "promoters" in controlling reaction velocity.

(*b*) The accelerating influence on slow combustion of addition to the medium of inert gases.

(*c*) The observation of an abrupt transition with some small change in experimental pressure or temperature from an immeasurably slow reaction to spontaneous ignition and vice-versa.

Only (*a*) need now be amplified, the reader being reminded firstly of H. B. Dixon's discoveries that the combustion of carbon monoxide is promoted by small amounts of water vapour and that the presence of traces of NO_2 induces in a remarkable manner the spontaneous ignition of combustible-air media generally, and secondly of Midgeley's discovery of the influence of lead tetra-ethyl in suppressing "knock" in internal combustion engines.

All these apparent abnormalities, which cannot be explained by the Arrhenius theory, have been readily accounted for on the basis of the chain theory of chemical processes, whereby it is recognized that the progress of an exothermic reaction depends upon specific encounters between certain reactive chemical species. The initial concentration of these may arise thermally according to the classical view, photochemically, or from an extraneous source; but in so far as it is relatively small in the early stages of a reaction, any factor either increasing or decreasing it will have an apparently disproportionate influence on the ultimate reaction rate. It is important to recognize that according to this view reaction is restricted to the activated centres participating and that general temperature rise does not occur in the system until reaction becomes rapid; the reaction rate is proportional to the number of reaction centres present at any moment and varies as these are either multiplied or destroyed (the "branching" and "breaking" of chains). The velocity depends, therefore, on a time factor as follows: rate $= Ae^{\phi t}$, where A = constant, ϕ = the net branching probability and t = time. The reactive centres are now usually regarded as atoms and free radicals.

Reverting again to the classical theory of flame propagation, it will now be apparent that no longer can one consider the latter as being conditioned by raising the medium ahead of the flame to an ignition temperature, but rather that in a certain unit volume of the mixture (subject to a temperature gradient) a critical number of reaction centres must be built up. The contributing factors will be as follows:

(*a*) Rising temperature due to conduction of heat from the flame front.

(*b*) Actual diffusion of centres from the flame front.

(*c*) The formation of centres photochemically by suitable emission from the flame.

(*d*) The presence of any "promoters" actually already present in the explosive mixture.

In the present state of knowledge, it is impossible to assess the relative importance of these factors. As the limits of inflammability are approached, however, it might be anticipated that (*c*) and (*d*) will become of increasing importance.

Chemical Sensitization

It may be pointed out that where the combustion of complex combustibles is concerned, consideration has to be given not only to the initial inflammable material, but to that of a number of stable intermediate compounds to which its partial combustion is known to give rise. In the case of methane, for example, formaldehyde, formic acid and methyl alcohol call for consideration.

When a hydrocarbon-oxygen mixture is first heated, active combination does not ensue immediately; there is a lag period during which very little oxygen is consumed, followed by a period of rapid reaction; this lag is usually regarded as a period during which an adequate concentration of some intermediate product is built up, at which point the whole reaction becomes autocatalyzed. The addition of many intermediate oxygenated products is known powerfully to promote the combustion as a whole, and aldehydes as a class are very potent in this respect. It is possible, therefore, that in certain circumstances where preheating of the mixture takes place, flame propagation may be enhanced owing to the addition of reactive centres to the mixture; this would furnish an example of (*d*).

The effect of (*c*) is very difficult to prove experimentally, and on this account is often neglected. It is quite likely, however, that it may be an important factor. It is easy to suppose that molecules in the act of combustion radiate characteristic energy which will be absorbed by other unburnt molecules, probably in the far ultra-violet, leading to their excitation and/or dissociation. This secondary activation may lead to combustion and on such premises it would not be difficult to formulate a theory in which the activation energy for combustion is largely propagated as radiant energy.

The Measurement of Flame Velocity

There are two principal methods of determining flame-speeds. In the one the actual velocity of travel through a stagnant mixture in a glass tube is measured, usually by means of a photographic record. The velocity increases with the diameter of the tube and varies according to the direction of propagation, i.e., whether horizontal, upward or downwards. The other method consists in measuring the ignition velocity from a study of the inner cone. When an explosive mixture fed at known constant velocity is burnt at the mouth of a burner, the ignition velocity may be assessed from the cone height, the cone angle* or the total area of the cone, the final value indicating the volume of explosive mixture burned in unit cross-section of the flame in unit time. The literature of this subject was reviewed comprehensively by J. W. Wood and A. H. Eastwood in the 40th Report of the Joint Research Committee.[2]

It may be added that although the actual values of flame-speeds found in glass tube experiments are approximately twice as great as the ignition velocities determined in burner experiments, it has been shown by H. F. Coward and F. J. Hartwell[3] that when the area of the travelling flame-surface is estimated by means of snapshot photographs and the "fundamental speed of flame" calculated in a manner similar to that employed in determining ignition velocities, there is rough agreement between the results obtained by the two methods; further, the difference in actual flame velocities through mixtures contained in tubes of varying diameter is readily accounted for when the areas of the flame envelopes in each case are compared.

While there is general agreement between "fundamental speeds" and "ignition velocities," one of the most interesting features brought out in the review published in the 40th Report was the lack of agreement between the results of the various investigators who have used the burner method; this was illustrated diagrammatically by a comparison of the ignition velocity-composition curves for individual gases obtained by different workers.

The obvious difference between the manner of burning in flames travelling through stagnant mixtures and stationary flames in flowing mixtures is that whereas in the former case the flame is convex and travels through an unheated medium, in the latter case the flame is inverted and the mixture is preheated as it approaches the flame front. Were the effect purely thermal, one would merely expect a tendency for increase in flame-speed, but the matter may not be quite so simple; it is possible that some slow combustion may take place in the mixture and in the present state of knowledge it is difficult, as already stated, to predict the result of this. An added factor is that at the apex of the inner cone the absolute radiation intensity would be abnormally great; this may account for the rounding of the cone tip.

Apart from the interest which attaches to these varying factors as providing a possible explanation of the divergent results of previous workers with different burners, attention may be directed to the interesting observations of F. A. Smith and S. F. Pickering[4], who recently examined systematically the ignition velocities of flames on burners of varying diameter. While ignition velocity should be a property of the mixture concerned, Smith and Pickering found it to vary materially with burner diameter; moreover, the differences observed were not unidirectional, the velocities being greater with small diameter burners in the case of mixtures with defect of air and less in the case of mixtures with excess of air. They

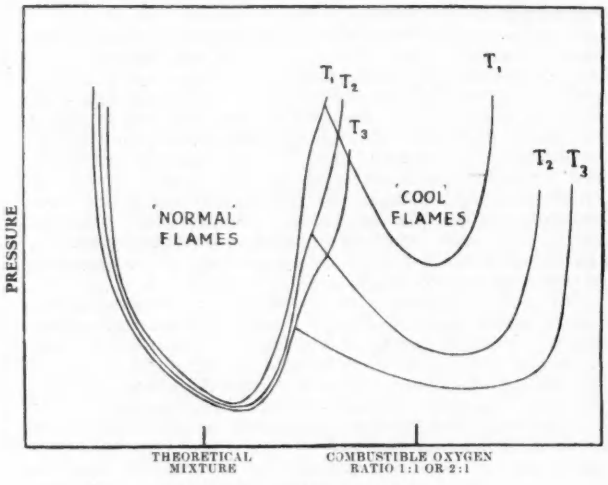
* At a specified radius.

examined the matter from the point of view of physical factors, particularly the "overhang" of the flames, but it remains an open question whether the surface/volume ratio of the cones was not an important factor from the point of view of chemical sensitization.

In addition to the possibility of the formation of reactive centres from intermediate products, passing reference may also be made to the likely influence of small amounts of other extraneous materials acting either as inhibitors or promotors. It will need no emphasis, for example, that were carbon monoxide the only available combustible gas, the efficiency of appliances might be at the mercy of the humidity of the atmosphere. From knowledge of the powerful promoting influence of small amounts of nitrogen peroxide during slow combustion it would also seem not unlikely that this material might also enhance flame velocity. As an example of an inhibitor, mention may be made of iron carbonyl. Some ten years ago A. C. Egerton and S. F. Gates[5] found small amounts of this material to have a marked influence in reducing flame velocity with the slow travelling flames of carbon monoxide and air. Recently, also, Wood and Eastwood* have observed that the presence of 0·1 to 0·2 per cent of it in a town gas altered the A.T.B. Number from 84 to 96.

IV EVIDENCE OF ABNORMAL FLAME-SPEED AND STRUCTURE

Another question which has recently come into prominence and is of interest in that it may relate to burner problems is whether in all cases flame-speed-percentage curves are necessarily quite regular. Most experimental work, whether



Typical "Normal" and "Cool" Flame Ranges

in tubes or in burners, has naturally been carried out at atmospheric pressure; it is now apparent, however, that a proper understanding of flame phenomena will only be arrived at when wide pressure ranges have been covered, for under such conditions a much more comprehensive view of the problem can be obtained, and factors which might be disregarded in experiments at any one pressure then brought to light.

As an example, it has recently been discovered that all hydrocarbons and their derivatives with more than three carbon atoms in the molecule give rise not only to normal flame ranges but also to cool flame ranges, as illustrated graphically in the Figure. The normal flame range centres approximately upon the theoretical mixture for complete combustion and the cool flame range usually upon a mixture of 2:1 or 1:1 combustible:oxygen ratio, or that which is most reactive in slow combustion. Little need be said here about the chemical nature of a cool flame, except that it is a slow-travelling, barely-luminous chain reaction and combustion in it is incomplete. The cool flame ranges occur at lower pressures as the temperature is raised and eventually the two ranges overlap more and more.

At higher pressures in the cool flame range a two-stage process is observed, a second but hotter flame being initiated in the cool flame products; subsequently the two flames coalesce and the propagating flame then has a double structure. A matter of great interest is whether at the overlapping of the normal and cool flame ranges the speeds of normal flames are in any way affected. The measurement of flame-speeds in this region therefore forms part of the present investigations.

It is also obvious that the cool and normal flame ranges are usually only well separated with complex molecules. With simpler combustibles the media which are most reactive in slow combustion are themselves within the range for ordinary flames; and whether or not they give rise to cool flames is a matter which will only be settled by more thorough investigation.

It is not unreasonable to suppose that in certain circumstances a cool flame process may in fact form some part of the normal flame structure. Were this to occur critically with change of pressure or mixture composition in any particular case, one might expect a corresponding change in the character of the flame. In this connexion attention may be drawn to some interesting observations of E. C. W. Smith, who, during his tenure of the Radiation Fellowship at the Imperial College of Science and Technology, London[6], studied the spectra of stationary flames in ethylene-air mixtures at pressures below and above atmospheric. Among other things he made the observation that at any one pressure the flame became luminous with a critical change in mixture composition, due to the presence of carbon aggregates; and on plotting this point against pressure, part of a curve in the normal flame range was found.* It appeared that were it extended it would centre upon mixtures of similar composition to that holding in the case of cool flames, as though some change in the slow combustion reaction ahead of the flame occurred under certain critical conditions. There was also every indication that the flame velocity might be subject to an abrupt change at the same point.

It may be recalled also how the inner cones of aerated Bunsen flames of higher hydrocarbons are not uniform in appearance; they are, in fact, divided into a number of light and dark segments. If enough primary air be added, the inner cone rotates at the head of the burner.[7] The phenomenon has usually been ascribed to aerodynamical factors but it seems that its chemical aspects may repay investigation.

The Structure of the Normal Flame Front

In addition to what has been already stated, it should be added that recent researches by H. Sachsse,[8] H. F. Coward and W. Payman,[9] and W. E. Garner and A. Pugh[10] have tended further to invalidate the classical thermal view of flame propagation. It is still recognized, however, that temperature is an important factor contributing to flame propagation; thus Garner states: "A view consistent with the experimental results is that the flame is carried forward by radical chains, but that certain branching processes in these chains require assistance from the thermal energy of the gas." Coward and Payman state: "The indication is that the 'bursting into flame' is a consequence of the arrival not so much of sufficient heat as of a sufficient concentration of active particles. . . ." B. Lewis and E. von Elbe[11] have also calculated values in agreement with experiment for the velocity of flame movement in the case of the ozone flame on the basis of the combined effect of diffusion of active particles and heat flow carrying the reaction zone forward into the unburnt gas.

W. Jost and L. von Muffling[12] appear to hold very similar views and attach great importance to the influence of the diffusion of radicals ahead of the flame into the unburnt gas. They point out that there is a locus in the flame front where the gases are neither gaining nor losing heat by conduction. This position corresponds with that at which Mallard and Le Chatelier assumed self-ignition to occur. On this view, therefore, the flame front might be regarded as divided into two zones, neither of which is independent of the other. In the first zone, which might be most readily affected by inhibitors and promoters, activation is mainly of a chain character; while in the second zone it is

* Private communication.

* Thus, on two atmospheres pressure all ethylene-air mixtures give rise to luminous flames, irrespective of large excess of primary air.

mainly thermal. It may further be added that according to Jost's recent views on detonation, the first zone may be propagated at some distance in front of the second, provided it is supported by a sufficiently intense shock wave.[13]

In a recent communication to the Chemical Society the Authors have described in some detail flames having a double structure (see page 12) similar to the normal flame as here envisaged; these flames were, however, slow travelling, both zones being propagated as chain reactions.

The Authors desire to thank the Governor and Directors of the Gas Light and Coke Company for allowing one of them (M.M.) to spend a year at Leeds University, for the purpose of initiating some investigations relating to the subject matter of this Paper.

APPENDIX

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A Comparison of Producer Fuels

From a Paper to the Scottish Junior Gas Association (Eastern District)

By

A. A. MITCHELL, Penicuik

THIS Paper does not aim at justifying the use of one type of fuel to the exclusion of others for producers. It is rather a comparison of various sizes of fuel, with reference to the conditions obtained by, and the results and financial aspect of, the different fuels used.

I propose at the outset to give a brief description of the carbonizing plant, &c., at the Dunfermline Gas-Works, where the observations were made. The carbonizing plant to be considered comprises 5 beds of 4 retorts each, Woodall-Duckham continuous vertical retorts (fireclay). The capacity of each retort is 4½ tons and the producers are of the inside type, one for each bed of retorts. The waste gases are utilized in a waste-heat boiler fitted with a steam-driven fan, and this arrangement ensures a constant vacuum in the main flue.

The retorts are drawn every 2 hours, and the coke is carried by a G.B. conveyor to a C.C.L. screening plant constructed on top of a concrete coke hopper, capacity 500 tons. In this screening plant the coke is divided into three sizes—viz., breeze 0 in.-⅜ in., coke nuts ⅜ in.-¼ in., and coke over ¼ in.

Previous to the construction of this hopper and the installation of the screening plant, the coke was discharged from the retorts into a bogie, which was then taken by hoist to the top of a hopper and there tipped over a screen. The coke was again screened as it was run out of the hopper into wagons by passing it over a ¼ in. mesh screen. This screened coke was used as producer fuel, being tipped from the wagon into a hopper and elevated by the G.B. conveyor. The mixture of breeze and nuts obtained at the first screen had a limited sale to builders and often required additional screening to eliminate the nuts, to which the builders objected. There was no demand for coke nuts, and these mixed with small coal were used as boiler fuel. This method involved considerable handling and there was always a considerable quantity of breeze left over for which no market was available, and which was used to form a railway embankment.

With the new screening plant, three definite sizes of fuel were produced as stated before. The plant was put into operation in May, 1935, and during the year 1935-36 unscreened coke, or screened coke and additional breeze were used as producer fuel. Breeze mixture was gradually increased till a limit of 30% breeze was reached, beyond which the results obtained were not satisfactory.

This led in the following year to the use of coke nuts as producer fuel. By utilizing this size of fuel, which had previously been used for boiler firing, it was thought that the increase of saleable coke, over ¼ in., would easily justify the change, even taking into account the increase in the amount of boiler fuel which would have to be purchased.

It is now the practice here to use coke nuts in the producer, the nuts being run out of the hopper into wagons. The wagons are tipped and the nuts elevated by the conveyor. If the coke hopper is full, thus precluding screening by the plant, no coke nuts are available and run-of-retort coke is used, this being elevated by the conveyor direct into the producer storage hopper.

Attention to Fires

The producers, 5 in number when the full bench is under fire, are attended to by one fireman, whose shift is from 5 a.m. to 1 p.m. The fireman goes over each producer in turn every day, raking out the ashes. It was found in the case of screened coke that the use of false bars, or spearing, as we term it, was only necessary when clinker formed, and thus by proper attention to steaming, spearing was required only very occasionally. With unscreened coke and coke nuts, spearing is required more frequently—every 18 or 20 days with unscreened coke and every 10 or 12 days with coke nuts. With these two fuels, clinker formation has not been in the least troublesome. The spearings are not necessitated by clinker deposit but rather by the fire becoming too dirty. The smallness of the fuel does not permit of the fireman cleaning the fire so thoroughly, as excessive loss would occur by the fuel falling through the bars. The drops obtained with periodical spearing, however, clean the fire sufficiently for the periods previously mentioned.

These spearings tend to cause a more serious drop in flue temperature than do the ordinary cleanings or the spearings with screened coke:

1. It is found necessary to have the producer doors open over a longer period with the steam shut off.
2. As stated before, the small fuel runs readily through the fire bars, with the result that a greater quantity of fuel is extracted. Thus at the next filling a large body of wet, cold fuel is dropped into the producer, causing a cooling throughout the bed.

This second effect may be minimized by filling the producer, after a spearing, in two stages instead of one. This reduces the sudden cold shock of such a large mass and by the time the second quota is dropped in, the bed will have recovered its heat, to a certain extent at least.

With screened coke, unscreened coke, coke-breeze mixtures, and coke nuts, good carbonizing heats can be readily maintained. The temperatures in the flues are taken with a pyrometer each morning by a technical assistant whose duty it is to maintain heats, attend to producer conditions, retort speeds, &c. The working temperature maintained is about

1300°C. at the top sight brick. The retorts are heated downwardly.

A series of tests was carried out on the ash in the producer with (1) screened coke, (2) unscreened coke, and (3) coke nuts as fuel. The ash contents show an appreciable difference. For one ton of fuel to the producer, with screened coke, 19.0 cwt. are utilized, with unscreened coke 17.8 cwt., and with coke nuts 15.56 cwt. The fuel burning efficiency of the producer is the true ash content of the ashes taken out—viz., 95%, 89%, and 77.8% respectively. The market value of the various sizes must be considered, and it is not sufficient to give solely the value of so many tons of coke against so many tons of coke nuts, as other factors must be considered—viz., cost of each fuel into bunker, weight of fuel used, amount of steam required, steam generated in waste heat boiler, make of gas per ton of coal carbonized, increase in amount of boiler fuel purchased, and increase in amount of large coke available for sale when coke nuts are used.

Cost of Fuel into Producer

The actual cost of coke nuts and screened coke into the hopper is exactly the same, both being extracted from the retorts and lifted by the conveyor up to the screening plant, and thence to the different divisions of the storage hopper. The particular size of fuel, coke or coke nuts, is then drawn out of the hopper at the bottom into wagons, which are tipped and the screened fuel is again raised by the conveyor direct to the producer hopper. The unscreened fuel, on the other hand, is passed from the retorts into the conveyor and elevated direct to the producer hopper. This fuel is, therefore, actually cheapest into the hopper, but no extra wages are entailed with the other fuels, the only saving being in the wear and tear of the screening apparatus, &c.

Below is given a table with the amounts of coal carbonized, total fuel to producers, and fuel to the producers per 100 lb. of coal carbonized.

The fuel in 1935-36 comprised 1,800 tons unscreened coke, 360 tons breeze below ¼ in., 500 tons screened coke, which is equivalent on screening to 700 tons under ¾ in. and 1,960 tons above ¾ in.

The fuel in 1936-37 comprised 680 tons unscreened coke and 2,628 tons coke nuts, which is equivalent on screening to 2,754 tons under ¾ in. and 554 tons above ¾ in.

The figures given for the other years are for screened coke, as screened in the old hopper before the installation of the C.C.L. plant.

Year.	Type of Fuel to Producer.	Coal Carbonized. Tons.	Fuel to Producer. Tons.	Consumption per 100 lbs. Coal Carb. Lb.	Coke Sold per ton. Coal Carb. Cwt.	Average No. of beds under fire.
1931-32	Screened coke	21,177	4,354	20.5	8.27	4.14
1932-33	" "	22,002	4,255	19.3	8.35	4.61
1933-34	" "	22,879	3,692	16.1	8.00	4.40
1934-35	" "	23,026	3,522	15.3	8.07	4.24
1935-36	26% below ¾ in. / 74% above ¾ in.	22,834	2,664	11.7	8.44	4.14
1936-37	83% below ¾ in. / 17% above ¾ in.	32,706	3,308	14.0	10.24	4.10

The 1936-37 figures compare very favourably with the figures for the other years, being only surpassed by those of 1935-36 when the larger fuel was used.

Boiler Fuel

The question of producer fuel is, in our case at least, necessarily linked with that of boiler fuel. Before the introduction of breeze mixtures and coke nuts for producer firing, these coke nuts were used along with coal dross in a Lancashire boiler. The table below gives the quantity and type of fuel used each year in the boiler from 1929, with the amount of water evaporated. For comparative purposes, consider three years—1931-32 being taken as a year before the installation of the C.C.L. screening plant and change of producer fuel, 1935-36 when mainly run-of-retort coke was used in the producer, and 1936-37 when coke nuts were used in the producer and coal dross or pearls were bought in to take their place in the boilers. Three boilers are used for the generation of steam—viz., a waste-heat boiler, a Lancashire, and a Cochrane, the last mentioned only being used when the Lancashire is off for cleaning.

Year.	Breeze to boilers. Tons.	Coal to boilers. Tons.	Total fuel to boilers. Tons.	Water evap. Lancs. and Cochrane. Gallons.	Water evap. in W. Heat Boiler. Gallons.	Total water evaporated. Gallons.
1929-30	2,478	780	3,258	3,649,200	2,007,800	5,657,000
1931-32	2,021	594	2,615	2,976,900	1,576,960	4,553,860
1932-33	1,996	1,209	3,205	4,546,020	491,260	5,037,280
1933-34	3,152 Coke nuts	367	3,519	4,326,900	329,360	4,656,260
1935-36	3,064	866	3,930	4,707,760	834,470	5,542,230
1936-37	434	2,150	2,584	3,937,310	1,419,700	5,357,010

The increase in water evaporated during 1935-36 and 1936-37 is accounted for by the installation of a concentrated liquor plant. It may be stated here that with coal dross firing in the Lancashire boiler, less forced draught is required, less ashes have to be dealt with, and less dirt is deposited on surrounding buildings, rhones, &c., saving money both in men's time and in property deterioration, the dirt being now deposited in the flue to a much greater extent. Also the boiler is not working to its full capacity but has a considerable reserve.

Let us presume for comparative purposes that the three boilers were required to evaporate 5,542,230 gallons of water in each of the three years 1935-36, 1931-32, and 1936-37, and that the increased amount of water required in the last two years mentioned was evaporated by coal dross. The fuel required would then have been, by calculation:

Year.	Breeze to Boilers. Tons.	Coal to Boilers. Tons.	Total Fuel to Boilers. Tons.
1931-32	2,021 Coke Nuts.	1,207	3,226
1935-36	3,064	566	3,930
1936-37	434	2,265	2,699

Taking these totals at the current price, the costs of boiler fuel for the three years mentioned are approximately

1931-32 .. .. .. £900
1935-36 .. .. .. £650
1936-37 .. .. .. £1,700

Thus the increase in boiler fuel costs in 1936-37 over those of 1931-32 is £800 and over 1935-36 £1,050.

Coke Available for Sale

Again consider these same three years from the aspect of the gross makes of coke and breeze per ton of coal carbonized:

1931-32 .. .. .. 14.29 cwt.
1935-36 .. .. .. 13.46 cwt.
1936-37 .. .. .. 13.40 cwt.

The fuel used on the works in boilers and producers for these three years is shown in the following table, and by difference the amount of coke available for sale is found:

Year.	BOILERS, &c.		PRODUCERS.		Boilers plus Producers per ton Coal carb. Cwt.	Coke sold per ton Coal carb. Cwt.
	Gross. Tons.	Per ton Coal carb. Cwt.	Gross. Tons.	Per ton Coal carb. Cwt.		
1931-32	2,021	1.91	4,534	4.11	6.02	8.27
1935-36	3,064	2.69	2,664	2.33	5.02	8.44
1936-37	434	0.37	3,308	2.79	3.16	10.24

Thus 1936-37 shows an increase of 1.97 cwt. over 1931-32 and 1.80 cwt. over 1935-36 of coke sold per ton of coal carbonized. For comparative purposes, presume that the same amount of coal had been carbonized in each of these three years—viz., 22,834 tons. Thus, by using coke nuts in the producers, 1936-37 shows an increase in coke sold over 1931-32 of 2,249 tons, equal to £2,811, and over 1935-36 of 2,055 tons, equal to £2,569. Against these must be put the increased costs of boiler fuel—viz., £800 and £1,050 respectively, showing a net increased revenue of £2,011 over 1931-32 and £1,519 over 1935-36, due to the changes made in producer and boiler firing. These increases are equivalent to 1.17d. per 1,000 cu.ft. or 0.20d. per therm respectively.

It is obvious that producer-firing by coke nuts, at the Dunfermline Works at least, is clearly justified and is a sound proposition, utilizing as it does to the best and most profitable advantage the different sizes of fuel.

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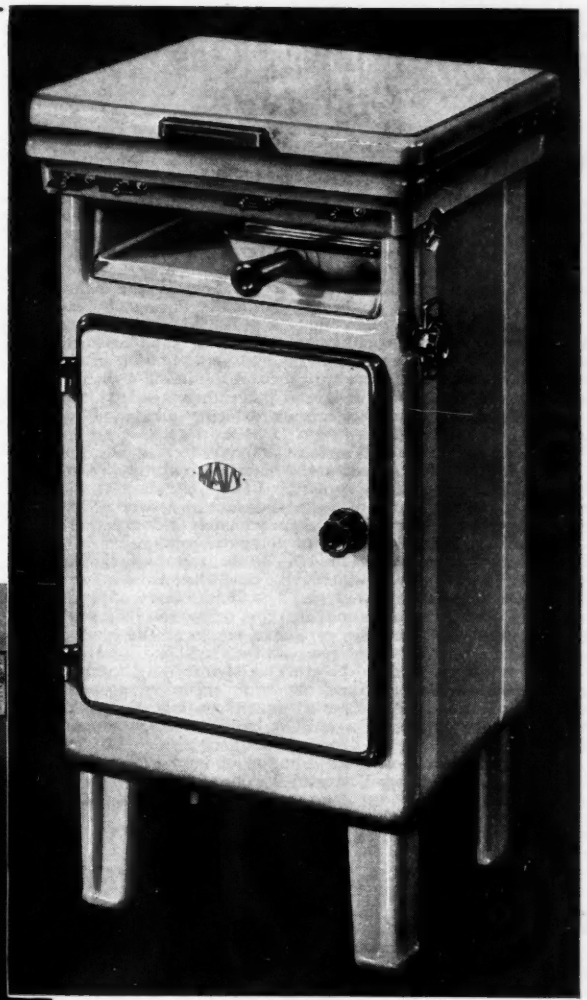

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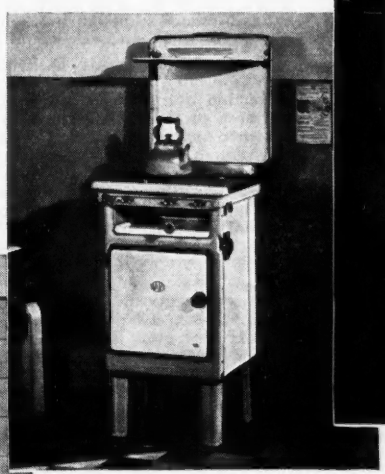

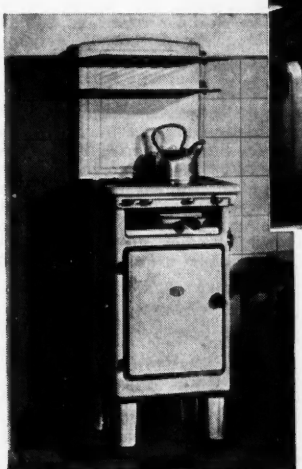

The illustrations from left to right show:—

1. The 527 De Luxe Cooker with Enamelled Double Plate Rack and Backplate.
2. The 526 Dapple Cooker with Hinged Cover incorporating Folding Shelf
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Atmosphere Protection in Paint and Varnish Manufacture

New Inert Gas Generator

By

HARRY W. SMITH, Junior,

American Gas Association

WITHIN the past two years, paint and varnish men have watched with interest a rapidly widening application in their industry of a new type of apparatus—the inert gas generator. These devices burn carefully controlled mixtures of regular gas and air within closed chambers, purify and scrub the products of combustion, and thus deliver (or generate) at very low cost large volumes of absolutely inert gases which neither burn nor support combustion, but which are valuable in the paint and varnish plant for: (1) "blowing" synthetics during cooking, (2) excluding air (oxygen) from contact with heated batches of varnish or oil, (3) eliminating troublesome skinning of paint or varnish in plant storage, (4) preventing the gradual accumulation of gummy layers of oxidized paints and varnishes on the inside walls of large storage tanks, (5) extinguishing and preventing fires, and even (6) minimising skinning in the can or reducing oxidation during grinding or homogenizing.

At the Cook Paint and Varnish Company, Detroit, the vertical-tower type of inert gas generator manufactured by Continental Industrial Engineers, Inc., is used. The unit was installed in early May of 1939, and is of a size sufficient to deliver 2,500 cu.ft. of useful inert gas every hour. Approximately 250 cu.ft. per hour of natural gas (which requires for complete combustion 9½ times as much air by volume) is burned in the refractory-lined combustion cylinder under automatically controlled conditions so as to produce an inert gas analyzing: 88% nitrogen; 10% carbon dioxide; ½ to 1% carbon monoxide; and a fraction of a per cent. water vapour. This analysis, of course, relates to the products of combustion after they have been cooled, scrubbed, and purified in the towers connected to the cracking chamber. The input gas and air are automatically and accurately mixed in proper ratio before combustion, and are pushed into the combustion or cracking cylinder by means of a positive pressure, displacement-type blower.

The particular method of distribution of inert gas used by the Cook Paint and Varnish Company involves a two-cylinder compressor which delivers the inert gas to a small tank (50 cu.ft. capacity) so fitted with relief valves as constantly to maintain the gases at 80 lb. per sq. in. pressure. Thus the compressor always acts against a constant head. From this small tank the gas flows to the main storage tank (10,000 gallons capacity), where it is limited to 40 lb. per sq. in. pressure, and from which it is piped to its various places of application throughout the plant. Incidentally, a valved "Y" is provided just beyond the compressor so that when the generator is started up from a cold condition its output may be wasted into the atmosphere until the continuously recording analyser which is part of the control equipment shows that no oxygen is present in the inert gas.

At the Cook Paint and Varnish Company the gas is used both to agitate synthetic resins and varnishes which are cooked at 350° F. to 650° F. (depending upon the product) in some six kettles (five of 9,000 lb. capacity, and one of 3,000 lb. capacity), as well as to displace all air from over the boiling ingredients. Also, the inert gas is used to eliminate skinning in approximately 100 varnish storage tanks ranging in capacity from 1,000 to 3,000 gallons each. Piping and valves are so arranged that an inert gas pressure of ½ lb. per sq. in. is automatically maintained over the stored liquids, irrespective of the rate at which they are drawn. At the moment, this plant has not made provision for the emergency use of its large inert gas output for fire prevention or extinguishment, although it was indicated a few months ago that piping for such purposes would likely be installed in the future.

As for the results, Mr. D. E. Eichelberger, Assistant Vice-President, indicates that the current cost of providing atmosphere protection over varnish kettles is only approximately one-fifth of the cost previously sustained to supply bottled carbon dioxide for these same operations. Further, the atmosphere protection over stored liquids is a tremendous advantage heretofore never enjoyed at this plant—and one which eliminates the necessity for periodically taking storage tanks out of use and expensively and laboriously cleaning the accumulated substances from the internal walls.

Trade News

A New Gas Plant Catalogue

Ashmore, Benson, Pease, & Co., Ltd., of Stockton-on-Tees, have issued a new Gas Plant Catalogue in which they refer especially to the introduction of welding and to the advent of Meehanite metal as outstanding innovations in the construction of gas plant during the past decade. Gasholders of all types and capacities are now supplied either entirely welded or of riveted construction, or a combination of welding and riveting. Welded steel purifiers of the largest capacities have also been designed, fabricated, and erected by the Company and are specially adapted for the higher pressures now prevailing in gas-works practice. Steel condensers and other plant are also being installed of welded construction. The Company have recently added to their equipment an X-ray apparatus which is used for the examination of important welds. Meehanite, of which Ashmore, Benson, Pease & Co., are the first licensees and pioneers in this country, is being increasingly adopted in the construction of purifiers. It is a high duty metal possessing exceptional strength and extraordinary resisting qualities to wear, abrasion, heat, and corrosion.

Crossley-Premier Engines

The various types of duty to which horizontal heavy duty oil engines have been put in the past, and the special duties for which they are suitable in connexion with the propelling of vessels and the driving of auxiliaries in the future are described in a book issued by Crossley-Premier Engines, Ltd., of Sandiacre, near Nottingham, entitled "Horizontal Heavy Duty Oil Engines." The publication is a text book in itself, containing no fewer than 40 pages and opening with an excellent reproduction in colour of a cross-section through a Vis-a-Vis oil engine. The Vis-a-Vis principle, pioneered by Crossley Brothers, Ltd., in 1893, was developed by Crossley-Premier Engines, Ltd., from 1928 onwards, until to-day, despite the "fashion" for vertical engines, this engine has a unique reputation for reliability, economy, accessibility and simplicity. The Crossley-Premier horizontal Vis-a-Vis oil engine is essentially a slow speed heavy duty engine of simple, robust design. It has consistently demonstrated its ability to take into its stride an unusual amount of strenuous work over long periods with a minimum of attention. In addition to oil engines the book gives particulars of Crossley-Premier Vis-a-Vis horizontal Diesel engine compressor sets and Crossley Diesel, petrol-paraffin, and gas engines.

The Harland Trailer Fire Pump

The special features of the Harland trailer fire pump are described in an illustrated booklet issued by the Harland Engineering Co., Ltd., of Alloa. The pump has been designed and produced in accordance with the Office of Works specification and has been proved by exhaustive trials. It is of the single stage type with an efficiency equal to that of many two-stage pumps. The trailer is designed to withstand heavy shocks, and the pump, engine, and equipment are so mounted that the unit can be towed rapidly over rough surfaces with safety. Four other new publications also received from the Harland Engineering Co. deal respectively with the "Spiroglide" multi-stage pump, borehole pumps, "Duoglide" two-stage horizontal pumps, and large D.C. motors.

Street Lighting Units

William Sugg & Co., Ltd., Ranelagh Works, Chapter Street, S.W.1, have published an illustrated leaflet giving particulars of their conversion gas lighting units certified to comply with British Standard Specification B.S./A.R.P. 37. These are of two types, each giving an illumination of 0.0002 foot-candle. One type is suitable for panel street lanterns, the other for globe lamps.

Yorkshire Junior Gas Association

Session Re-opened

In accordance with a recent decision of the Council of the Yorkshire Junior Gas Association, the winter session—suspended temporarily owing to war conditions—was re-opened on Jan. 27 with the annual general meeting and election of officers. As three normal monthly gatherings had been lost, the Presidential Address was presented, instead of the normal custom of hearing an opening Address by a member of the Senior Organization. Mr. A. WYLIE, of Sheffield, presided at the outset.

Submitting the 36th Annual Report, the HON. SECRETARY (Mr. R. H. McCulloch, of Sheffield) recorded nine interesting general meetings, including a joint visit with the Manchester Junior Association, to the works of Stewart & Lloyds, Ltd., at Corby. Membership of the Association was now 174, a net decrease of 17, but this was due largely to an unusually large number of members having secured promotion and gone to other parts of the country. Mr. R. N. Webb, of Leeds, one of the Association's founders and past-President, had been made an Honorary Life Member and had undertaken to make an annual presentation for three years for the best short Paper read before the Association. The Yorkshire District Gas Education Committee had held several meetings and recorded appreciation to the Principals of Technical Colleges in various centres for their help in operating the Educational Scheme of the Institution of Gas Engineers.

The Statement of Accounts showed a credit balance of £41, as against £47 3s. at the end of the previous year.

The following officers and Council were elected:

President.—Mr. T. G. Lewis (Leeds).

Senior Vice-President.—Mr. F. Beaumont (Huddersfield).

Junior Vice-President.—Mr. A. Pickard (Knottingley).

Hon. Treasurer.—Mr. Thos. Hayes (Leeds).

Hon. Secretary.—Mr. G. E. Banks (Sheffield), succeeding Mr. R. H. McCulloch.

Members of Council.—Messrs. V. J. J. Siddons (Rawmarsh), J. Castle (Brighouse), D. C. Gunn (Leeds), F. H. Nicholls (York), and Mr. A. Wilkinson (Huddersfield).

Representatives on the District Education Committee were Messrs. A. H. Clucas (Leeds), G. Griffiths (Bradford), A. Pickard (Knottingley), re-elected, and Dr. H. A. Fells (Sheffield). Hon. Auditors reappointed were Messrs. A. W. Arnold and J. R. Firth, both of Bradford.

After his investment as President Mr. T. G. LEWIS presented to Mr. Wylie the Association's customary past-President's medallion as a souvenir of a year of useful office. Mr. WYLIE, responding, voiced thanks to his fellow officers and to the members generally for warm friendship and loyal support, and made particular mention of the arduous services of Mr. McCulloch as an Hon. Secretary, which they were sorry to be losing owing to requirements of added responsibilities in his own professional activities. They would all wish his successor (Mr. Banks) every success and encouragement.

Mr. W. S. HUBBARD (Leeds), proposing thanks to the retiring President and officers for their work during the past year, also paid special tribute to Mr. McCulloch's secretarial services during the past five or six years. Mr. Hubbard felt thanks were also due to the Directors and General Manager (Mr. Ralph Halkett) of the Sheffield and District Gas Company for the generous facilities they had allowed to the Association's President (Mr. Wylie) and Mr. McCulloch in carrying out their responsibilities.

Mr. D. C. GUNN (Leeds) seconded.

Mr. MCCULLOCH, requested from the Chair to reply for the retired officers, said he regretted the necessity to relinquish the Hon. Secretaryship, but he was certain they would find an excellent successor in Mr. Banks, who was also of the Sheffield Undertaking. Mr. McCulloch voiced his personal appreciation of the kindness of the Directors of the Sheffield Company, of his chief, Mr. Ralph Halkett, and also of Mr. Ralph Halkett, Junior, in making it possible for him to give the time necessary to the secretarial work.

Mr. T. G. LEWIS, the new Chairman, then gave his Presidential Address.

Best Short Paper

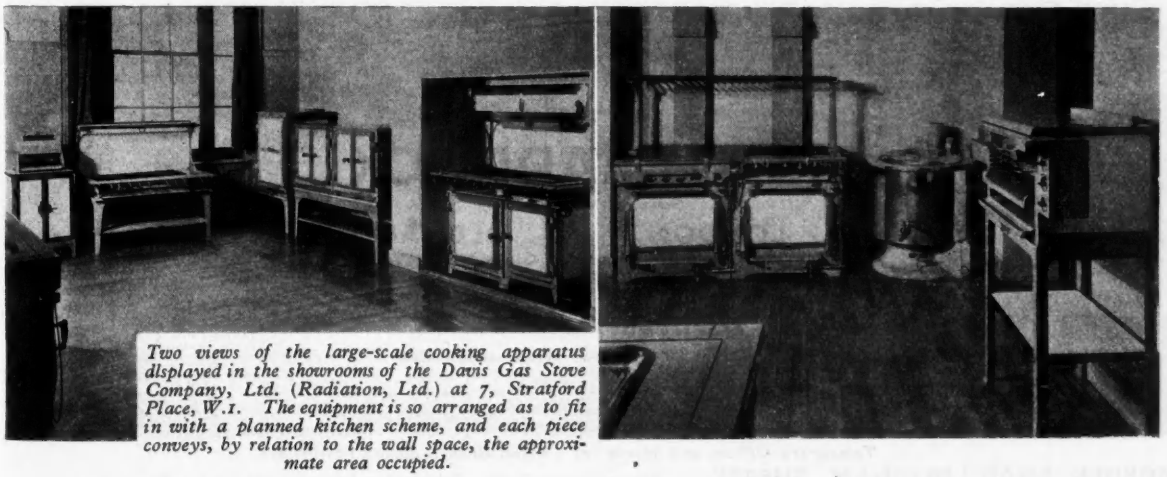
Mr. R. N. WEBB, presenting his award for the best Short Paper delivered before the Association during the past session, congratulated Mr. J. W. Stacey (Sheffield) on a contribution which, in the judgment of the Council, had earned the award, for his Paper on the Testing of Silica Refractories. Mr. Webb complimented Mr. Wylie on a year of wise leadership in the chair, and voiced good wishes to Mr. Lewis in the responsibilities he had accepted in such an anxious period as the present. Mr. Webb also added his tribute to the work of Mr. McCulloch, who had shown himself one of the best hon. secretaries the Association had had. Mr. Banks would have, he was sure, the warm support and encouragement of all the members in following in the footsteps of his predecessor.

The PRESIDENT extended the Association's congratulations and good wishes to the members of the Association who had gained important promotions during the year, and also to Mr. W. S. Hubbard, of Leeds, who had brought honour to the Association by securing awards of the Institution's Bronze Medal, the S.B.G.I. Silver Medal, and the Clayton Award for his Paper "Choice of Gas Storage."

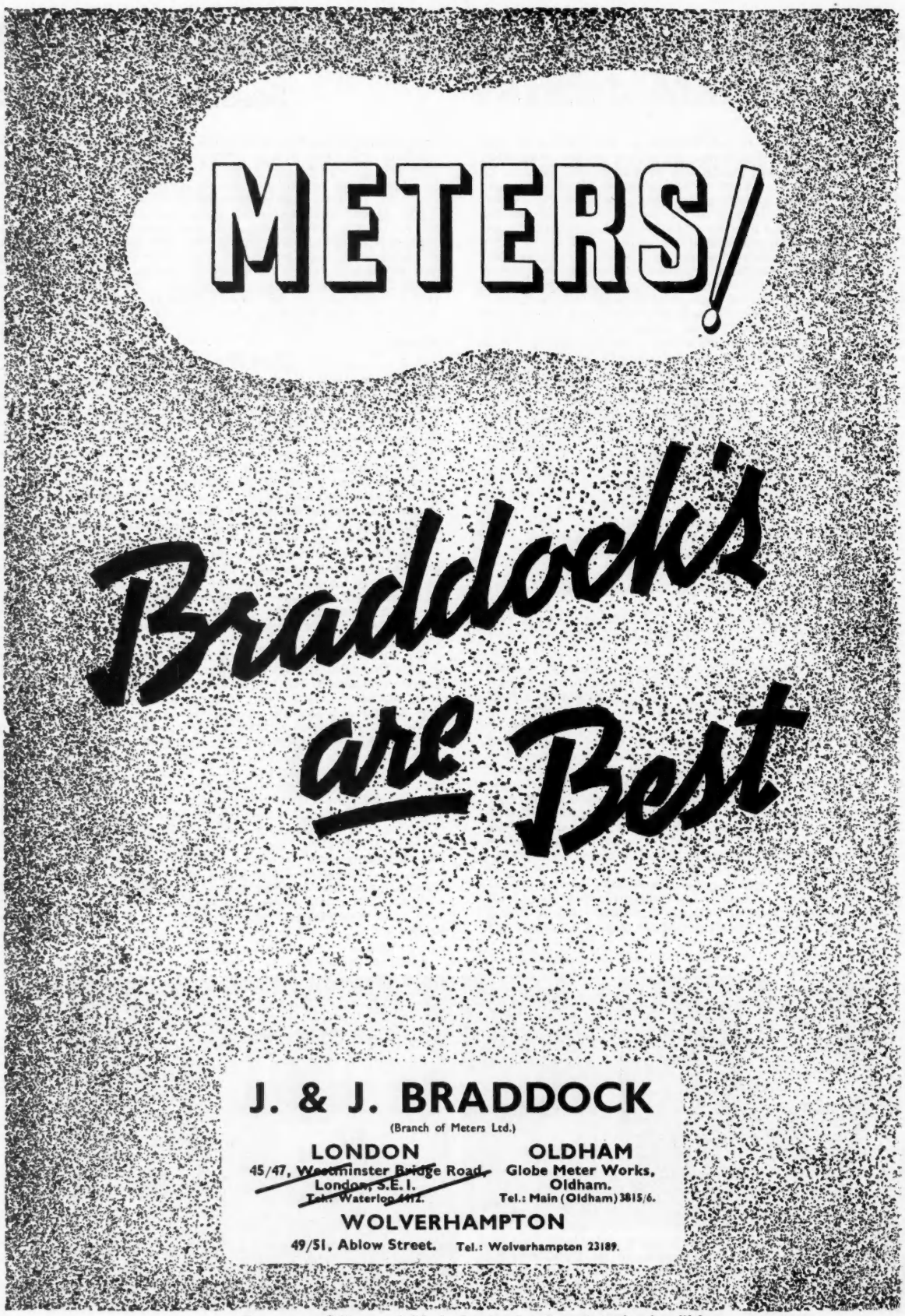
On the motion of Mr. C. A. NEWHAM (Leeds), seconded by Mr. J. W. GAME (Bradford), thanks were voiced to Professor Townend and the authorities of Leeds University for again offering hospitality of their rooms for the Association's annual meeting, as they had done ever since the inception of the Association.

Mr. H. J. HODSMAN, of Leeds University, responded and regretted the inability of Professor Townend to be present.

The following provisional syllabus for the remainder of the session was announced: Feb. 24, at Bradford, Paper by Mr. S. H. Stokes (Elland) on "Economic Utilization of Unscreened Coke Breeze"; March 30, at Leeds, Paper by Mr. L. W. Roberts (Harrogate) on "The Construction of the West Yorkshire Gas Grid" (illustrated by lantern and cinema) and an inspection of plant installed at Meadow Lane Works, Leeds, since the Association's last visit there; April 20, venue to be announced, Short Paper Day —Mr. M. Hamshaw (Brighouse) on "Steaming in Horizontal Retorts," and Mr. J. Hargreaves (Bradford) on "Foundations," with possibly a third Paper; and May 25, venue to be announced, with a Paper expected to be given by Mr. A. E. Wilson (Huddersfield).



Two views of the large-scale cooking apparatus displayed in the showrooms of the Davis Gas Stove Company, Ltd. (Radiation, Ltd.) at 7, Stratford Place, W.1. The equipment is so arranged as to fit in with a planned kitchen scheme, and each piece conveys, by relation to the wall space, the approximate area occupied.



Temporary Offices and Works for London Branch during hostilities:
MORDEN ROAD, MITCHAM, SURREY. Telephone No. 2124. Telegraphic Address: "Metrique, Phone, London."

Current Sales of Gas Products

The London Market

Feb. 5.

There is little of interest to record in the London tar products market, to-day's values being as under :

Pitch about 35s. per ton f.o.b.

Creosote about 5d. per gallon.

Refined tar 3¾d. to 4d.

Toluole is now controlled by the Ministry of Supply Order No. 1, which fixes the maximum price at which this material may be sold.

Pure benzole about 1s. 10d.

95/160 solvent naphtha about 1s. 11d.

90/160 pyridine 15s. to 16s.

All per gallon naked.

Refined naphthalene crystals about £20 per ton in bags.

All *ex* makers' works.

The Provinces

Feb. 5.

Crude Gas-Works Tar, 19s. 3d. to 24s. 3d.

To avoid misunderstanding, it is necessary to state that the above price is not claimed to represent a market value. It is a price worked out from week to week upon a system which has been used for many years as a basis for the fixing of certain contracts for crude tar of varying qualities in different areas.

The average prices of gas-works products during the week were : Pitch—East Coast, 32s. 6d. to 35s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 32s. 6d. to 35s.* Toluole, naked, North, 1s. 9½d. (Controlled by the Ministry of Supply Order No. 1, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North, 9d. to 9½d. Solvent naphtha, naked, North, 1s. 8d. to 1s. 9d. Heavy naphtha, North, 1s. 4½d. to 1s. 5½d. Creosote, *ex* works, in bulk, North, liquid and salty, 4¾d. to 5d.; Scotland, 4½d. to 5d.; low gravity, 4¾d. to 5d. Carbolic acid, 60's. 3s. 3d. to 3s. 4½d. Naphthalene, £15 to £20. Salts, 75s. to 85s., bags included. Anthracene, "A" quality, 4½d. to 4¾d. per minimum 40% purely nominal. Heavy oil : Unfiltered anthracene oil, (min. gr. 1,080), 5½d. to 5½d. ; filtered heavy oil (min. gr. 1,080), 5¾d. to 6d. ; heavy anthracene oil gr. less than 1,080, 6d. to 6¼d.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls, whatever they may be.

Scotland

GLASGOW, Feb. 3.

Enquiries continue quite numerous, but new business is not too active. Deliveries against contract are, however, proceeding rapidly.

Crude gas-works tar.—The actual value of this is round 34s. to 36s. per ton *ex* works in bulk.

Pitch.—Makers are continuing to quote 25s. to 27s. per ton f.o.b. for export, and about 25s. per ton *ex* works in bulk for home trade.

Refined tar.—Home business is slow, but export orders are fairly numerous. Prices are maintained at 3¾d. to 4d. per gallon in the home market, and 2¼d. to 2¾d. per gallon for export, both naked at makers' works.

Creosote oil.—A fairly steady throughput is maintained with prices as under : Specification oil, 5d. to 5¼d. per gallon ; low gravity, 6d. to 6¼d. per gallon ; neutral oil, 5½d. to 5¾d. per gallon ; all *ex* works in bulk.

Cresylic acid.—New business is not easily arranged and prices are approximately as follows : Pale, 97/99%, 2s. 2d. to 2s. 4d. per gallon ; dark, 97/99%, 1s. 10d. to 2s. per gallon ; pale, 99/100%, 2s. 6d. to 2s. 9d. per gallon ; all *ex* works in buyers' packages.

Crude naphtha.—Available supplies command round 7d. per gallon *ex* works in bulk, according to quality.

Solvent naphtha.—90/160 grade is 1s. 8d. to 1s. 9d. per gallon and 90/190 heavy naphtha is about 1s. 4d. to 1s. 5d. per gallon.

Motor benzole is called 1s. 6¼d. to 1s. 7d. per gallon.

Pyridine.—Prices are nominal at 15s. to 16s. per gallon for 90/160 grade and 17s. to 18s. per gallon for 90/140 grade.

Contracts Advertised

Coal.

Cannock District Gas Co., Ltd. [p. 314.]

Results at Perth (W.A.)

The progress in gas sales which has characterized the operations of the City of Perth (Western Australia) Gas Department for some years past was continued during the twelve months ended Sept. 30 last ; the sales having amounted to 422,445,000 cu.ft., as compared with a total of 408,260,000 cu.ft. in the preceding financial year. For the first time since 1931, a portion of the coal carbonized (about 25%) was English. At September last the number of meters connected was 25,907, a gain of something over 1,200 during the twelve months. The total length of mains and services laid is a trifle over 401 miles. The net profit on this occasion is £56,689—some £1,400 less than a year ago. This is a result which, in view of extra costs incurred by wage increases, &c., is regarded as most satisfactory. The sum of £14,300 is contributed to street lighting. The remarks with which the General Manager (Mr. F. C. Edmondson) concludes his report just about sum up our own opinion upon the situation : "It was not until four years after the Great War had finished that we came back to the 1914 level of profits. In view of this, it seems to me that this Department should not observe the common slogan 'Business as usual,' but strive to obtain 'Business a little better than usual,' in an endeavour to counteract the effect of war, with its dislocation of business and industry, combined with rising costs."

A.R.P.
PROTECTION OF SANDBAGS.

METRO CREOSOTE EMULSION

METRO COPPER CREOSOTE EMULSION

Both Emulsions conform to the Specification of the Ministry of Home Security Memorandum A.R.P. 279/1939 — 20/10/39, and are available in GREEN at slight additional cost.

SOUTH METROPOLITAN GAS CO.

REGIS HOUSE,
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CARBONIZING PLANT

COAL AND COKE HANDLING PLANT

✷

West's Gas Improvement Co., Ltd.

trust that Gas Engineers will not hesitate to send them their enquiries for new plant, renewals and spare parts, relying upon them to do their very best, under whatever conditions may exist from time to time, to fulfil as heretofore their obligations to the Gas Industry.

Works & Head Office : **Miles Platting, Manchester 10** - *Telephone*—Collyhurst **2961-5**

London Office (Temporary Address) : Bath Rd., Harmondsworth, W. Drayton, Middlesex *Tel.*—West Drayton **2288/9**

GAS STOCKS AND SHARES

The main item of interest on the Stock Exchange last week was the activity in home rail stocks. This followed the Prime Minister's intimation that the terms of the agreement between the Government and the Companies would be made known this week. The debenture and guaranteed stocks now stand considerably higher than at any time during last year, and, supplies being short, they will doubtless improve still further. There was also a good demand for gilt-edged stocks, although, after some week-end selling, prices finished below the best; 2½% Consols closed half a point higher than a week ago at 74¼. With few exceptions, notably bank shares, industrials were irregular, while the more speculative markets remained dull and uninteresting.

The Gas Market opened strongly, and for the first two days the number of recorded transactions was heavier than usual. The activity eased up as the week progressed, though there were no reactions on this account; on the contrary, some fixed-interest stocks made further progress. The only drop of note was that of 5 points in South Suburban ordinary to 74½ on the reduced final dividend. On the Provincial Exchanges improvements took place in Bristol, Derby, and Sheffield stocks. It will be noticed that several "ordinaries" became ex div. on January 29.

Further dividend announcements for the past half-year have been made, and it is satisfactory to note that some are maintained at their pre-war levels. Among last week's results appear the following:

	Final. %	Corresponding. %	Total for Year. 1939.	1938.
Cambridge 10% max. ...	5	5	10	10
do. 7% max. ...	3½	3½	7	7
do. 5% max. ...	2½	2½	5	5
Cardiff	£2 13s.	3	£5 13s.	6
East Hull	£2 4s. 3d.	2½	£4 14s. 3d.	5
East Surrey	2⅛	3	5⅜	6
Newcastle	2.59	2⅞	5.09	5⅜
Northampton	2½	2½	5	5
Romford	4	4	8	8
South Suburban ...	1½	3	4½	6
Sunderland	3	3	6	6

Official Quotations on the London Stock Exchange

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Feb. 2	Rise or Fall on Week.
1,767,439	Sept. 4	8	8	Alliance & Dublin Ord. ...	115—125	...
374,000	Dec. 27	4	4	Do. 4 p.c. Deb. ...	80—90	...
877,576	Nov. 6	5	5	Asscd. Gas & Water U'd'ts Ord.	14/6—16/6	...
500,000	,,	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	17/—19/—	...
535,545	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	15/—17/—	...
318,730	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	13/6—15/6	...
750,000	Sept. 18	3½	3½	Do. 3½ p.c. Red. Deb. ...	80—85	...
560,070	Aug. 21	7	7	Barnet Ord. 7 p.c.	110—120	...
300,000	Oct. 9	1/9⅔	1/4⅔	Bombay, Ltd.	19/6—20/6	...
181,185	Aug. 21	9½	9½	Bournemouth Sliding Scale ...	147—152	...
690,526	,,	7	7	Do. 7 p.c. max. ...	120—125	...
493,960	,,	6	6	Do. 6 p.c. Pref. ...	115—120	...
50,000	Dec. 18	3	3	Do. 3 p.c. Deb. ...	68—73	...
362,025	,,	4	4	Do. 4 p.c. Deb. ...	90—95	...
335,000	,,	5	5	Do. 5 p.c. Deb. ...	105—110	...
367,900	Aug. 21	7½	7½	Brighton, &c., 6 p.c. Con. ...	105—110	...
659,955	,,	6⅔	6⅔	Do. 5 p.c. Con. ...	100—105	...
205,500	,,	6	6	Do. 6 p.c. 'B' Pref. ...	130—105	...
888,000	Sept. 18	8	7	British Ord.	90— 95	...
100,000	Dec. 18	7	7	Do. 7 p.c. Pref.	120—125	+2
350,000	,,	5½	5½	Do. 5½ p.c. 'B' Cum. Pref.	110—115	...
120,000	,,	4	4	Do. 4 p.c. Red. Deb.	73—78	...
450,000	,,	5	5	Do. 5 p.c. Red. Deb.	98—103	...
100,000	22 May '33	6	4	Cape Town, Ltd.	¼—¾	...
100,000	6 Nov. '33	4½	4½	Do. 4½ p.c. Pref.	¼—¾	...
150,000	Dec. 18	4½	4½	Do. 4½ p.c. Deb.	55—65	...
626,860	Jan. 29	6	5 5/16	Cardiff Con. Ord.	100—105*	−2
237,860	Dec. 18	5	5	Do. 5 p.c. Red. Deb. ...	95—100	...
98,936	Oct. 9	2/—	2/—	Colombo Ord.	1⅛—1⅛	+1/16
24,510	,,	1/4⅜	1/4⅜	Do. 7 p.c. Pref.	20/6—22/6	...
739,453	Sept. 27	−/11.48	−/11.48	Colonial Gas Assn. Ltd. Ord. ...	15/—17/—	...
296,144	,,	1/3.30	1/3.30	Do. 8 p.c. Pref.	20/6—22/6	...
1,775,005	Jan. 29	4	2	Commercial Ord.	45—55*	−2
140,000	Aug. 21	4	4	Do. 4 p.c. Red. Pref. ...	88—93	...
620,000	Dec. 11	3	3	Do. 3 p.c. Deb.	58—63	...
286,344	Aug. 21	5	5	Do. 5 p.c. Deb.	92—97	...
280,000	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	94— 99	...
807,560	July 31	7	7	Croydon sliding scale	100—105	...
644,590	,,	5	5	Do. max. div.	81—86	+1
620,386	Dec. 27	5	5	Do. 5 p.c. Deb.	97—102	...
208 660	Aug. 21	5	5	Dudley, Brierley Hill & Dist. Ord.	100—105	...
82,275	,,	5	5	Do. 5 p.c. Con. Pref. ...	95—100	...
79,000	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	94—99	...
239,000	Jan. 29	5	88/6	East Hull Ord. 5 p.c. ...	80—90*	...
167,215	Aug. 21	6	5½	East Surrey Ord. 5 p.c. ...	98—103	...
176,211	Dec. 18	5	5	Do. 5 p.c. Deb. ...	90—100	...
250,000	Nov. 13	8	4	Gas Consolidation Ord. 'B' ...	14/—17/—	...
250,000	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	16/—18/—	...
19,152,410	Jan. 29	5⅜	3⅜	Gas Light & Coke Ord. ...	16/9-17/9*a	−−/3
2,600,000	,,	3½	3½	Do. 3½ p.c. max. ...	59—64*	−2
4,477,106	,,	4	4	Do. 4 p.c. Con. Pref. ...	81—86*	−2
2,993,000	Jan. 2	3⅜	3⅜	Do. 3⅜ p.c. Red. Pref. ...	83—88	...
8,602,497	Nov. 27	3	3	Do. 3 p.c. Con. Deb. ...	75—80	+1
3,642,770	,,	5	5	Do. 5 p.c. Red. Deb. ...	102—107	+3
3,500,000	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	100—105	+1
700,000	Sept. 4	3½	3½	Do. 3½ p.c. Red. Ded. ...	85—90	...
270,466	July 31	6	6	Harrogate New Cons.	95—100	...
157,500	Mar. 20	‡1/—	‡1/—	Hong Kong and China Ord. ...	¼—¾	...
5,600,000	Oct. 23	12	4	Imperial Continental Cap. ...	78—83	...
172,810	Jan. 29	3½	3½	Do. 3½ p.c. Red. Deb. ...	80—85*	−1
63,480	Dec. 18	3	3	Maidstone 3 p.c. Deb.	55—60	...
45,000		†10	†8	Malta & Mediterranean ...	92—102	...
				Metropolitan (of Melbourne) ...		
392,000	Oct. 2	5½	5½	5½ p.c. Red. Deb.	95—100	...
231,977	Aug. 21	5	5	M.S. Utility 'C' Cons.	75—80	...
968 ,658	,,	4	4	Do. 4 p.c. Cons. Pref. ...	75—80	...
390,076	Dec. 18	4	4	Do. 4 p.c. Deb. ...	72—82	...
148,955	Dec. 18	5	5	M.S. Utility 5 p.c. Deb. ...	95—100	...
125,000	Jan. 2	3½	3½	Do. 3½ p.c. Red. Bds. ...	90—95	...
675,000	Nov. 6	†3	†4	Montevideo, Ltd.	50—60	...
250,000	Aug. 21	7½	7½	North Middlesex 6 p.c. Con. ...	105—115	...
396,160	Jan. 29	5	5	Northampton 5 p.c. max. ...	90—95*	...
300,000	Nov. 6	†7	9	Oriental, Ltd.	118—128	...
468,537	Dec. 11	8	7	Plymouth & Stonehouse 5 p.c.	98—103	...
621,667	July 31	8½	8½	Portsmouth & Gosport Cons.	111—116	...
241,446	,,	5	5	Do. 5 p.c. max.	80—90	...
73,350	,,	5	5	Do. 5 p.c. Pref.	88—93	...
75,000	,,	4	4	Do. 4 p.c. Pref.	75—80	...
114,000	July 31	5	5	Preston 5 p.c. Pref.	90—95	...
247,966	Dec. 18	4	4	Primitiva 4 p.c. Cons. Deb. ...	93—98	...
625,959	Jan. 15	4	4	Do. 4 p.c. Red. Deb. ...	91—96	...
15,000	Sept. 4	6	6	San Paulo 6 p.c. Cum. Pref. ...	7½—8½	...
441,275	Oct. 9	1/1½	1/1½	Severn Val. Gas Cor. Ld. Ord.	16/6—18/6	...
460,810	Oct. 2	−/10⅝	−/10⅝	,, ,, 4½ p.c. Cum. Pref. ...	17/—19/—	...
133,201	Aug. 21	5	8½	Shrewsbury 5 p.c. Ord. ...	107—117	...
9,000	June 5	‡4	‡4	South African Ord.	4—5	...
1,996,297	Aug. 21	1/2⅜	1/2⅜	South East'n Gas Cn. Ld. Ord.	15/6—17/6	...
1,000,000	,,	−/10⅝	−/10⅝	Do. 4½ p.c. Red. Cum. Pref.	17/—19/—	...
769,191	,,	4	4	Do. 4 p.c. Cum. Pref. ...	14/6—16/6	...
150,000	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	90—95	...
6,709,895	July 31	6	5	South Met. Ord.	62—67	...
1,135,812	,,	6	6	Do. 6 p.c. Irred. Pref. ...	100—105	...
850,000	,,	4	4	Do. 4 p.c. Irred. Pref. ...	75—80	...
1,895,445	Dec. 27	3	3	Do. 3 p.c. Deb.	65—70	...
1,000,000	Jan. 15	5	5	Do. 5 p.c. Red. Deb. ...	100—105	...
600,000	,,	3⅜	3⅜	Do. 3⅜ p.c. Red. Deb. ...	92—97	...
1,543,795	July 31	6	6	South Suburban Ord. 5 p.c. ...	72—77	−5
512,925	,,	5	5	Do. 5 p.c. Pref.	90—95	...
500,000	,,	4	4	Do. 4 p.c. Pref.	78—83	...
250,000	,,	3½	3½	Do. 3½ p.c. Red. Pref. ...	85—90	...
888,587	Dec. 11	5	5	Do. 5 p.c. Deb.	98—103	...
250,000	,,	4	4	Do. 4 p.c. Deb.	77—82	...
200,000	July 31	3	3½	Do. 3½ p.c. Red. Deb. ...	85—90	...
427,859	Sept. 18	1/2⅜	9⅜	S. Western Gas & Water Ord.	13/—15/—	...
160,523	Oct. 9	−/10⅜	−/10⅜	Do. 4½ p.c. Red. Cum. Pref.	17/6—19/6	...
110,000	Dec. 18	4	4	Do. 4 p.c. Red. Deb. ...	90—95	...
750,541	July 31	5½	5	Southampton Ord. 5 p.c. ...	75—85	...
148,836	Dec. 27	4	4	Do. 4 p.c. Deb.	75—80	...
350,000	July 31	5½	5½	Swansea 5½ p.c. Red. Pref. ...	90—100	...
200,000	Dec. 18	3½	3½	Do. 3½ p.c. Red. Deb. ...	90—100	...
1,076,490	July 31	6½	6½	Tottenham and District Ord....	90—95	...
409,835	,,	5½	5½	Do. 5½ p.c. Pref.	100—105	...
62,235	,,	5	5	Do. 5 p.c. Pref.	90—95	...
453,380	Dec. 11	4	4	Do. 4 p.c. Deb.	80—85	...
1,247,505	Oct. 23	6	4	U. Kingdom Gas Cor. Ord. ...	13/—15/—	...
1,085,952	Nov. 20	4½	4½	Do. 4½ p.c. 1st Cum. Pref. ...	14/6—16/6	...
772,709	,,	4	4	Do. 4 p.c. 1st Red. Cum. Pf.	14/6—16/6	...
745,263	Dec. 18	4½	4½	Do. 4½ p.c. 2nd Non-Cum. Pf.	12/6—14/6	...
1,093,656	Sept 18	3½	3½	Do. 3½ p.c. Red. Deb. ...	85—90	...
378,106	Mar. 6	7	7	Uxbridge, &c., 5 p.c.	90—100	...
133,010	,,	5	5	Do. 5 p.c. Pref. ...	95—105	...
1,371,138	July 31	7	6½	Wandsworth Consolidated ...	85—90	−2
2,525,768	,,	4	4	Do. 4 p.c. Pref.	81—86	+1
1,343,964	Dec. 18	5	5	Do. 5 p.c. Deb.	98—103	...
383,745	,,	4	4	Do. 4 p.c. Deb.	80—85	...
400,000	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	90—95	...
558,342	Jan. 29	6½	6	Watford and St. Albans Ord. ...	95—100*	...
200,000	,,	5	5	Do. 5 p.c. Pref.	87—92*	−½
200,000	,,	5½	5½	Do. 5½ p.c. Pref.	92—97*	−½
200,000	,,	4	4	Do. 4 p.c. Rd. Pf. (1973/8)	85—90*	...
100,000	,,	33/4⅝	4	Do. 4 p.c. Red. Pf. (1959)	93—98*	−2
200,000	Dec. 11	3¼	3½	Do. 3½ p.c. Red. Deb. ...	83—88	...

a.—The quotation is per £1 of Stock. * Ex. Div. † Paid free of income-tax. ‡ For year. § Actual.

Supplementary List and Provincial Exchanges overleaf.

STOCK AND SHARE LIST—Contd.

Supplementary List, not Officially Quoted, London

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Nominal Quotations Feb. 2.	Rise or Fall on Week.
202,152	Sept. 4	5	5	Ascot Ord.	80—90	...
128,182	Dec. 27	5	5	Do. 5 p.c. Pref. ...	88—93	...
31,035	Aug. 21	–/4½	–/4½	Associated Utilities 4 p.c. Pref	15/—17/–	...
160,000	Dec. 18	3½	3½	Do. 3½ p.c. Red. Deb. ...	90—95	...
17,000	Aug. 21	8	8	Bognor Orig. Ord. 'A' ...	105—115	...
62,210	,,	8	8	Do. New Add. 'A' ...	105—115	...
87,160	,,	7	7	Do. New 7 p.c. max. ...	100—110	...
37,440	Jaa. 29	10	10	Cam. Univ. & Town 10 p.c. max.	110—120*	...
125,970	,,	7	7	Do. 7 p.c. max.	90—100*	...
39,025	,,	5	5	Do. 5 p.c. max.	80—90*	...
96,410	Jan. 29	4½	4½	Cardiff 4½ p.c. Pref.	90—95*	–2
55,520	July 31	6	6	Colchester 6 p.c. Pref.	95—100	...
90,550	Sept. 18	5	5	Do. 5 p.c. Deb. ...	100—105	...
160,000	July 31	4	4	Croydon 4 p.c. Pref.	70—75	...
130,000	Dec. 27	4	4	Do. 4 p.c. Deb.	80—85	...
65,000	Aug. 21	7½	7½	Eastbourne 'A' 5 p.c.	105—115	...
198,000	,,	6	6	Do. 'B' 3½ p.c.	90—100	...
112,312	,,	5	5	Do. 5 p.c. Pref.	90—95	...
180,000	Dec. 18	5	5	Do. 5 p.c. Deb.	95—105	...
130,500	Aug. 10	7½	7½	Exeter New Ord. (£10) ...	10—12	...
24,000	Aug. 21	8½	8½	Gt. Yarmouth 8½ p.c. max. (£30)	15—20	...
89,400	,,	7½	7½	Do. 7½ p.c. max. (£30) ...	10—15	...
81,160	Dec. 11	5½	5½	Do. 5½ p.c. Deb.	102—107	...
182,600	Sept. 4	9	8	Guildford Cons.	110—120	...
54,055	,,	5	5	Do. 5 p.c. Pref.	90—95	...
68,250	Dec. 11	5	5	Do. 5 p.c. Deb.	90—95	...
156,600	Aug. 21	7	7	Hampton Court Cons. ...	100—110	...
86,646	June 19	‡4½	‡5	Holyh'd&N.W.G.&W.Cpn.Ord.	13/6—15/6	...
80,000	Aug. 21	4	4	Lea Bridge 4 p.c. Pref.	65—75	...
60,000	,,	6	6	Do. 6 p.c. Pref.	105—115	...
94,876	Dec. 18	4	4	Do. 4 p.c. Deb.	75—80	...
73,620	Sept. 18	8¾	8¾	Luton Cons. 'A'	115—125	...
107,960	Sept. 18	5½	4	Mid Kent Ord. (£10)	7½—8½	...
230,940	July 31	10	10	Oxford & District Ord. ...	135—145	...
47,112	,,	5	5	Do. 5 p.c. Pref.	85—95	...
50,000	,,	6	6	Do. 6 p.c. Red. Pref. ...	100—105	...
126,193	Oct. 30	7½	7½	Peterborough Ord.	140—150	...
64,990	Sept. 18	7½	7	Redditch Ord.	100—110	...
166,850	July 31	8	8	Romford Ord.	110—120	...
60,800	,,	4	4	Do. 4 p.c. Pref.	85—90	...
44,000	Sept. 18	5	5	Do. 5 p.c. Deb.	95—100	...
25,570	July 31	5½	5½	Rugby 5½ p.c. Pref.	95—105	...
25,000	,,	6	6	Do. 6 p.c. Red. Pref. ...	100—105	...
42,750	Dec. 11	5½	5½	Do. 5½ p.c. Deb.	103—108	...
110,950	Aug. 21	8	8	Ryde Ord.	110—120	...
270,086	Sept. 4	7	7	Slough Ord.	100—110	...
21,000	Dec. 11	5	5	Do. 5 p.c. Deb.	92—97	...
28,872	Nov. 6	5½	5½	S. Midland Gas Cpn. Ltd. Ord.	14/—16/–	...
28,866	Sept. 18	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	14/—16/–	...
117,228	Aug. 21	7	5	Swindon Cons.	70—80	...
60,425	Dec. 18	5	5	Do. 5 p.c. Deb.	92—97	...
64,380	,,	5	5	Torquay & Paignton 5 p.c. Pref.	82—87	...
130,000	Aug. 21	8	5	Wakefield Ord.	85—95	...
81,650	,,	5	5	Do. 5 p.c. max.	75—80	...
82,000	Jan. 29	6	6	Weymouth Ord.	80—90*	...
273,626	Aug. 21	7	7	Wolverhampton Cons. Ord. ...	115—125	...
98,384	,,	6	6	Do. 6 p.c. Pref.	105—115	...
160,000	Dec. 18	5½	5½	Do. 5½ p.c. Red. Deb. ...	100—105	...
106,490	Aug. 21	5½	5½	Wrexham Ord.	70—80	...
90,000	Dec. 18	5	5	York 5 p.c. Red. Deb.	95—100	...
133,640	July 31	6½	6	Yorktown (Cam.) 5 p.c. Cons.	80—90	...
120,000	,,	5	5	Do. 5 p.c. Pref.	85—95	...
35,000	Dec. 18	5½	5½	Do. 5½ p.c. Deb.	103—108	...

BRISTOL EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Feb. 2	Rise or Fall on Week
347,756	July 31	6	5	Bath Cons.	101—105	–2
1,667,250	,,	5	5	Bristol, 5 p.c. max.	97—100	+1
120,420	Dec. 18	4	4	Do. 1st 4 p.c. Deb.	97—100	...
415,250	,,	4	4	Do. 2nd 4 p.c. Deb. ...	97—100	...
328,790	,,	5	5	Do. 5 p.c. Deb.	113—116	...
274,000	July 31	5	5	Newport (Mon.) Ord.... ...	93—95	...
13,200	Sept. 4	8½	7	Pontyp'l Gas & W. 10 p.c. 'A'	12—13	...
13,600	,,	6	5	Do. 7 p.c. 'B'	10½—11	...
40,000	,,	6	5	Do. 7 p.c. 'C'	10½—11	...
140,778	July 31	5	5	Weston-super-Mare Cons. ...	93—98	...
64,338	Dec. 27	4	4	Do. 4 p.c. Deb.	90—95	...
33,340	,,	7½	7½	Do. 7½ p.c. Deb.	140—150	...

LIVERPOOL EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Feb. 2	Rise or Fall on Week
157,150	July 31	6½	5	Chester 5 p.c. Ord.	100—103	...
92,500	Dec. 18	4	4	Do. 4 p.c. Pref.	80—84	...
36,430	,,	3½	3½	Do. 3½ p.c. Deb.	85—88	...
41,890	,,	4	4	Do. 4 p.c. Red. Deb. ...	95—99	...
2,167,410	Aug. 21	6	6	Liverpool 5 p.c. Ord.	101—103	...
245,500	Dec. 18	5	5	Do. 5 p.c. Red Pref. ...	94—99	...
306,083	July 17	4	4	Do. 4 p.c. Deb.	99—101	...
106,280	July 31	10	10	Preston 'A' 10 p.c.	174—184	...
188,219	,,	7	7	Do. 'B' 7 p.c.	126—136	...

NEWCASTLE EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Feb. 2	Rise or Fall on Week
122,577	Aug. 21	7	7	Blyth 5 p.c. Ord.	115—120	...
732,000	Aug. 21	3	3	Hartlepool G. & W. Co. & New	65—66	...
2,061,315	July 31	5½	5	Newcastle & Gateshead Con.	19/6—20/–a	...
682,856	,,	4	4	Do. 4 p.c. Pref.	88—90	...
776,706	Dec. 27	3½	3½	Do. 3½ p.c. Deb. '43 ...	78—80	...
277,285	April 24	5	5	Do. 5 p.c. Deb. '43 ...	98—103	...
332,351	Aug. 21	6	6	Sunderland 6 p.c. max. ...	109—109	...

NOTTINGHAM EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Feb. 2	Rise or Fall on Week
542,270	Aug. 10	9	6	Derby Con.	105—110	+2½
55,000	Dec. 18	4	4	Do. 4 p.c. Deb.	98—103	...
20,000	June 19	5	5	Long Eaton 5 p.c. Pref. ...	9—11	...
80,000	,,	5	5	Do. 5 p.c. Deb. ...	100—105	...

SHEFFIELD EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Feb. 2	Rise or Fall on Week
10,000	Aug. 21	10	10	Great Grimsby 'A' Ord. ...	170—180	...
6,500	,,	10	10	Do. 'B' Ord. ...	170—180	...
79,000	,,	10	10	Do. 'C' Ord. ...	160—170	...
1,806,339	Feb. 20	6½	6½	Sheffield Cons.	123—126	+4
95,000	Jan. 3	4	4	Do. 4 p.c. Deb.	98—100	...

a The quotation is per £1 of Stock.
* Ex. div. ‡ For year.

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